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DETERMINATION OF SATELLITE OBSERVABLES. VOLUME IV. OPTICAL PROPERTIES OF SATELLITE MATERIALS

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Avco Systems Division

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May 1974

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Volume IV Optical Properties of Satellite Materials

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The optical properties of selected satellite surface materials were measured; these materials included solar cells, thermal control mirrors reflective tape, and various painted surfaces. All samples were prepared using actual vehicle substrates and flight test assembly procedures. Measurement data reported include: (1) spectral directional reflectance (ρ_d) and/or emittance (ϵ_d) over the 0.24- to 22- μm spectral range;

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(2) bidirectional reflectance (ρ') at coherent wavelengths of 0.63, 1.06 and 10.6 μm and a visible solar simulation band extending from 0.4 μm to 0.7 μm; and (3) surface distribution information on samples having a significant specular component — given as direction normal orientation of individual sample elements. Instrumentation measurement techniques are discussed, and the results, showing significant specular returns from solar cells, are presented in tabular or graphical format. Data interpretation and variability are also discussed.

The Determination of Satellite Observables study effort is reported in four volumes: Volume I, Executive Summary; Volume II, Technical Report; Volume III, Technical Appendices, and Volume IV, Optical Properties of Satellite Materials.

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FOREWORD

(U) This final report of activities completed under Tasks 1 through 5 of the Determination of Satellite Observables (DSO) Study is submitted by the Avco Corporation, Systems Division to the Space and Missile Systems Organization (SAMSO) Air Force Systems Command, in accordance with Contract F04701-72-C-0353. The report is submitted in four volumes.

- Volume I - Executive Summary
- Volume II - Technical Report
- Volume III - Technical Appendices
- Volume IV - Optical Properties of Satellite Materials

(U) The reported activity was performed during the period 24 April 72 to 12 November 73, under the direction of Captain E. R. Dietz, with the assistance of Captain C. Baer and Lieutenant H. L. Harkleroad. The study is one element of the Observables Control/Decoying Program being performed under Captain Dietz's direction by SAMSO/DYAX. Dr's. J. Reinheimer and C. Francis, and W. Tuercke, of the Aerospace Corporation, provided valuable technical direction in the performance of the study.

(U) Mr. R. L. Ryan, manager of Military Space activities at Avco was full time Program Manager. He was assisted by: Mr. R. L. Blecher, Task Manager - Tasks 1, 2 and 3; and Mr. H. B. Winkler, Task Manager for Tasks 4 and 5. Avco was supported by the Environmental Research Institute of Michigan (ERIM - formerly the University of Michigan - Willow Run Laboratories) under subcontract, in the area of satellite materials optical properties measurements. Mr. M. Bair was the task manager for the ERIM subcontract. Supplemental measurements completed by ERIM under a separate direct contract from SAMSO, F047-72-C-0360, are reported in Volume IV of this document set.

(U) Valuable technical guidance and comments were provided to the SAMSO/Aerospace/Avco team by individuals from several organizations. In particular, the authors wish to thank:

- Messrs. Stewart, Tarka, Thompson, and Rawcliffe of the Aerospace Corporation.
- Dr. K. Kissell, E. Tyson, R. Vanderburgh, and Capt. J. Lambert of the AF Avionics Lab RSO Division.
- R. Wixted and P. D. Howes of the Avco Everett Research Laboratory.

(U) The following individuals at Avco and ERIM played key roles in the preparation of this report.

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SUMMARY

A measurement plan was developed and measurements carried out to provide SAMSO with the optical reflectance and emittance properties of selected satellite materials. Adequate measurements data were necessary to allow a first-order evaluation of the spatial and spectral properties of the materials over the spectrum extending from the UV, 0.24 μm, through the far infrared, 22 μm. These data will be utilized by SAMSO and their contractors to model the optical properties of the specific materials and/or satellites on which such materials are used.

Typical results of the program are illustrated in Figs. 1 and 2, where we have utilized measured data to model the reflectance distributions of two different solar cells illuminated by the sun. In each case a single solar cell is illuminated by the solar source at an incidence angle of 40° and the bidirectional reflectance is plotted on a logarithmic scale (one decade per division) to show the hemispherical distribution of reflected radiation. As is quite apparent from the illustrations, both cells have a large specular return as well as a diffuse component of low value; it is also apparent that both have a backscatter component somewhat larger than the diffuse level. Of primary significance is the fact that the Centralab cell has two specular reflections separated by a few degrees, whereas the Heliotek cell, as would be expected, has a single specular reflection. The model is qualitatively substantiated by comparing the results with actual photographs of the same phenomena (see Figs. 3 and 4 in Section 1).

If the distributions described above are compared to those often assumed in system evaluation, the significance of the illustration will be appreciated. Thus, according to standard procedure, the reflection would be assumed Lambertian—i.e., showing a constant hemispherical reflection. In such case, the value would be determined from the conventional directional reflectance (ρ_d) for which a nominal value of 10% (see Appendix B) would be used; this corresponds to the more or less constant surface seen on the base of the specular components in Figs. 1 and 2. Thus, in the standard system analysis, that radiation contained in the specular lobe is averaged over the entire hemisphere.

In order to carry out modeling of the type illustrated above, several kinds of pertinent data are required. First, one needs spatial data (bidirectional reflectance, ρ'): these data were measured on all samples at wavelengths of 0.4 to 0.7 μm, 0.63 μm, 1.06 μm, and 10.6 μm. Second, one must know the spectral properties of the materials; this information was obtained in the form of directional reflectance (ρ_d) and directional emittance (ϵ_d). Also, since a single measurement value may not adequately represent a material, several samples of each material were measured so that the statistics of variability could be determined. These data, as presented in the appendices of this report, are adequate for modeling the properties of a material.

Solar Simulation: 0.4 to 0.7 μm
Solar Incidence Angle: 40°

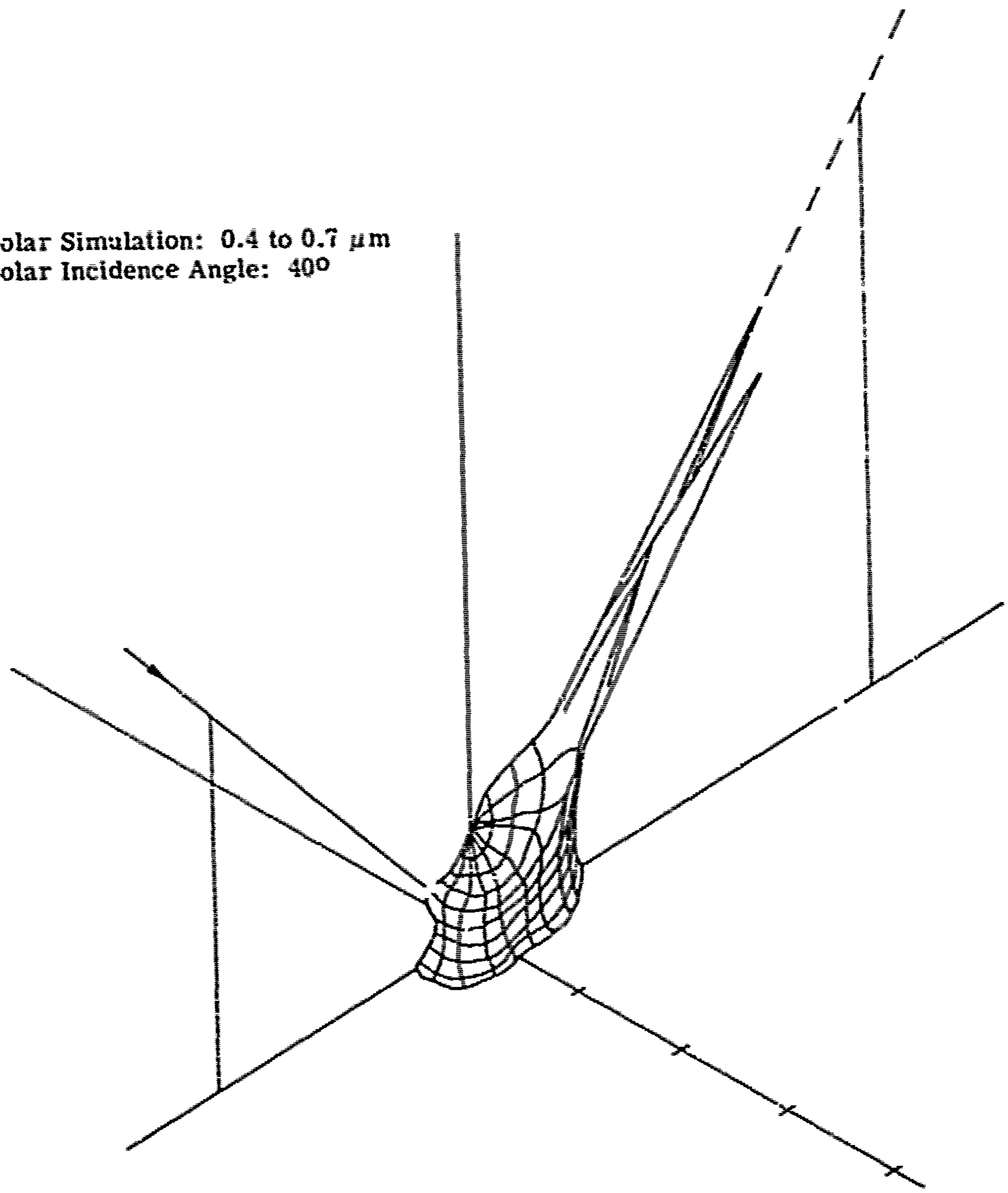

FIGURE 1. LOGARITHMIC REFLECTANCE DISTRIBUTION OF CENTRALAB SOLAR CELL

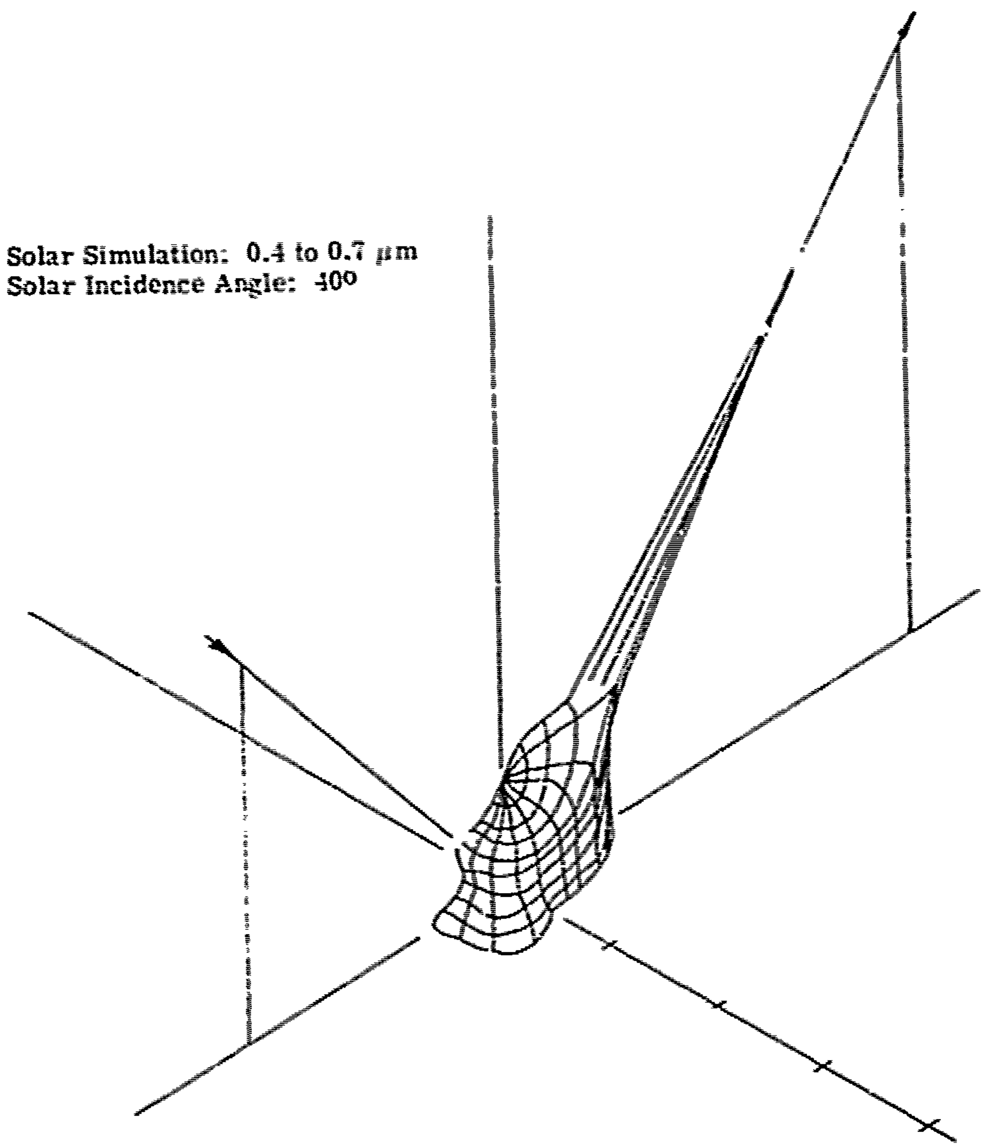

FIGURE 2. LOGARITHMIC REFLECTANCE DISTRIBUTION OF HELIOTEK SOLAR CELL

In modeling a vehicle, knowledge of the material properties is essential but must be complemented with detailed information on the geometric configuration. In most cases the vehicle has major geometric surface elements — planes, cones, spheres, etc. — which are assembled from various materials. Since many of these geometric surfaces are assembled from smaller elements, it is necessary to ascertain the orientation of these smaller elements. This is of prime importance for materials such as the solar cells and second-surface mirrors, which have specular characteristics. Therefore, it was necessary to determine the orientation of the individual elements by optically measuring the direction normal of each element (solar cells and mirrors) on the samples provided. From these data, the mean orientation and standard deviation of the composite surface can be established.

Using the data collected on this program, reflectance distributions can be modeled at other wavelengths in the 0.4- to 22-μm spectrum for the solar cells as shown above and similarly for the other sample materials measured. The other materials for which data are available include second-surface mirrors (Aerojet and TRW), and black as well as white paints.

Provided with the data contained in this report, and given an appropriate geometrical model of a satellite, the system designer can acquire a good radiation model of a vehicle which will permit both a qualitative and quantitative evaluation of any vehicle detection or signature. In order to preserve the measured data, a copy of the data is being retained on tape at ERIM for any projected future use by the sponsor or other authorized users.

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INTRODUCTION

The results of two complementary measurement programs on the optical properties of satellite surface materials are reported. The first program, entitled "Determination of Satellite Observables," (DSO), was initiated by Space and Missile Systems Organization (SAMSO), Air Force Systems Command, as a prime contract (F044701-72-C-0353) with AVCO Systems Division. ERIM supported the AVCO effort under Subcontract 244808, with the support objectives of initially assisting the prime contractor (AVCO) in developing a basic measurements program and then later, of performing the measurements, according to plan, on selected satellite surface materials.

The second program, a prime contract (F04701-72-C-0360) to ERIM, was entitled "Optical Measurement Program;" its objective was to measure the reflectance properties of selected satellite surface materials in order to determine spectral and spatial variability. The sample materials were selected in accordance with the measurement plan requirements developed on the DSO effort. Thus these two efforts were complementary and provided information allowing the calculation of satellite visibility/detection and signature.

To enable one to predict the visibility and/or signature of a particular vehicle, it is necessary to obtain the basic material parameter values which contribute to detection and the signature criteria. All satellite materials are characterized by reflectance and emittance functions that can make the vehicle visible to certain sensors operating in a particular spectral region. In the visible through near-infrared spectrum, the visibility of a satellite is a function of how much solar energy, earth albedo, and/or artificial illumination energy is reflected by the external parts of the vehicle structure and its component parts. Similarly, in the thermal regions (3-22 μm), the self-emission, reflection, and/or artificial illumination determine the visibility.

Visibility can be calculated from a geometric description of the satellite and a general description of the satellite and a general description of the optical properties of the vehicle surface. Numerous analyses have been attempted previously; all of them, however, only bound the problem and significantly diverge from reality for lack of adequate characterization of the reflectance and emittance of the surface materials of the satellite. That is, because measurement data were not available, surfaces were considered either specular or diffuse. (Generally, surfaces with low emittance tend to be specular while surfaces with high emittance are apt to be diffuse; but quantitatively, real materials are frequently unpredictable and usually neither diffuse nor specular.)

To carry out the design of a satellite, some optical property data and material characterization are required to maintain thermal balance at a given temperature. These include: total solar absorptance, α_s; total hemispheric emittance, ϵ_t; transmittance, τ; heat capacity, thermal conductivity, etc. An adequate thermal design is usually accomplished by selecting surfaces

having specific α_s/ϵ_t ratios such that a desired operating temperature can be maintained in a particular compartment. The α_s/ϵ_t characteristic of the surface enables the thermal designer to achieve the desired temperature equilibrium by making the satellite reflect the correct fraction of environmental flux impinging on the surface (sun, earthshine, moonshine, etc.) and causing it to emit the required amount of internally generated heat. For normal thermal balance considerations, α_s refers to solar flux absorption primarily in the 0.3 μm to 3 μm range; and ϵ_t refers to heat rejection for a source at about 300°K which has peak spectral radiance at about 10 μm. Data on heat rejection are available for all surface components of the satellite, but such data are completely inadequate to determine visibility. Two basic features are missing: spectral and spatial characterization of the surface reflectance, and emittance. It therefore, became necessary to design a program in which these basic features would be acquired.

The necessity for careful study of the spatial distribution of reflectance is illustrated by Figs. 3 and 4 which show the reflectance distribution of two different solar cells. In Fig. 3, the reflectance distribution of a cell manufactured by Centralab is photographed and can be compared to that of a cell manufactured by Heliotek (Fig. 4). Both of these cells meet flight test standards and are used interchangeably on actual flight vehicles. However, an assumption of either diffuse or spectral distribution would lead to gross errors in any detection or signature calculation. The only exception to this might be where the cells are used in large quantities and oriented over a hemisphere; in this case a diffuse assumption may be valid.

The quantity which describes the reflectance scattering property of a surface element δA can be defined as

$$\rho'(\vartheta_i,\phi_i;\ \vartheta_r,\phi_r) = \frac{L_r}{E_i} \tag{1}$$

where E_i is a source irradiance and L_r is the reflected radiance (see Fig. 5). This quantity is the bidirectional reflectance or, more appropriately, may be termed the reflectance distribution function. This function is related to the more familiar directional reflectance (ρ_d) by

$$\rho_d = \int_h \rho'(\vartheta_i,\phi_i;\ \vartheta_r,\phi_r)\,d\Omega' \tag{2}$$

The function ρ_d is the wavelength-dependent reflectance function commonly measured. Measurements of both quantities are convenient for characterizing any reflecting surface. (Note: All measurements angles are given relative to the sample normal and an arbitrary azimuth position located in the sample plane.)

Routine measurement of the directional reflectance for the selected samples provides their wavelength dependence in the 0.24 to 2.6 μm spectrum. Adding this data to the directional emissivity leads to adequate description of the wavelength dependence of each material over the entire spectrum of concern.

FIGURE 3. SPATIAL DISTRIBUTION OF INCIDENT (0.63 μm) AND REFLECTED RADIATION FROM A CENTRALAB SOLAR CELL

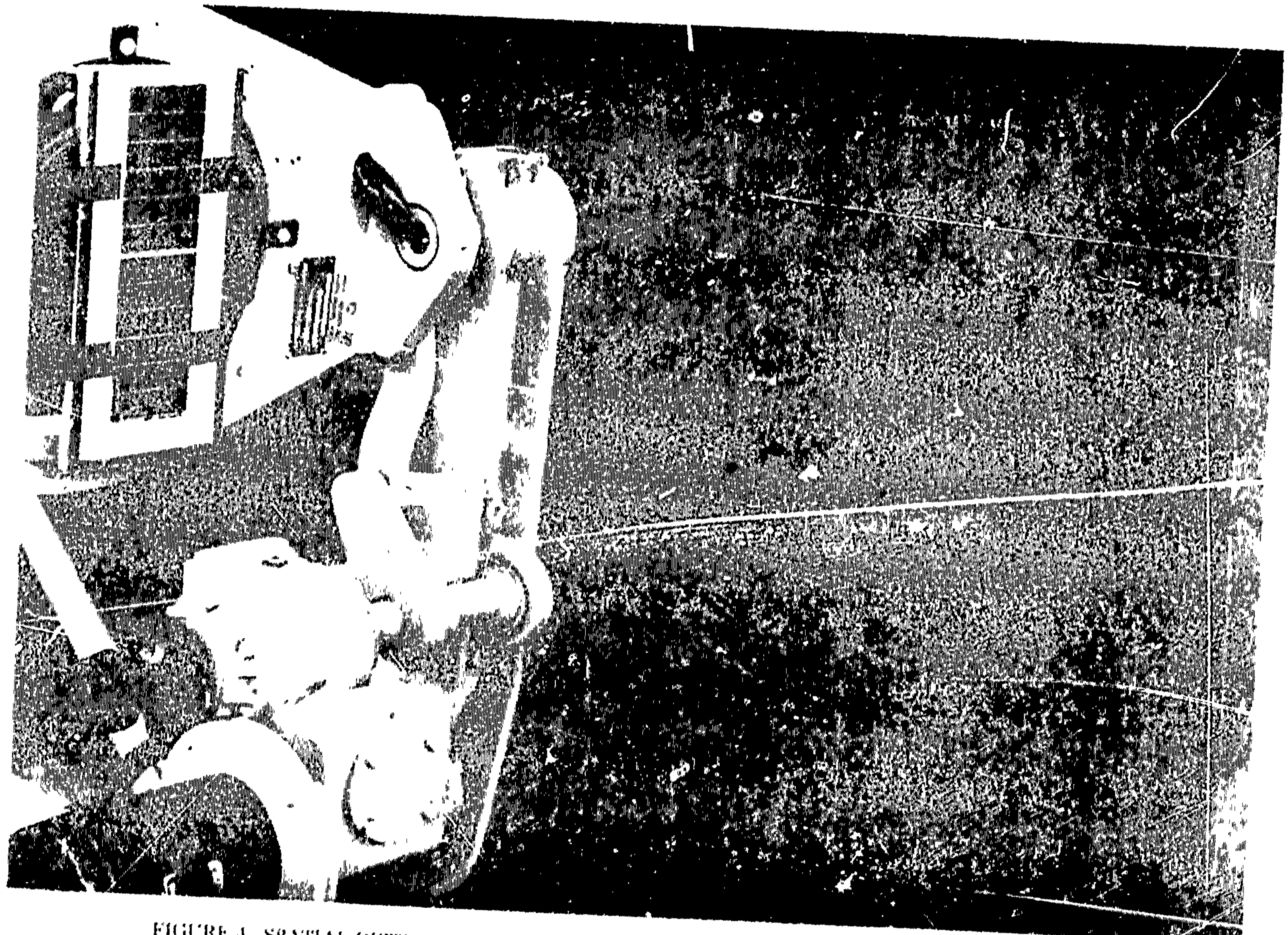
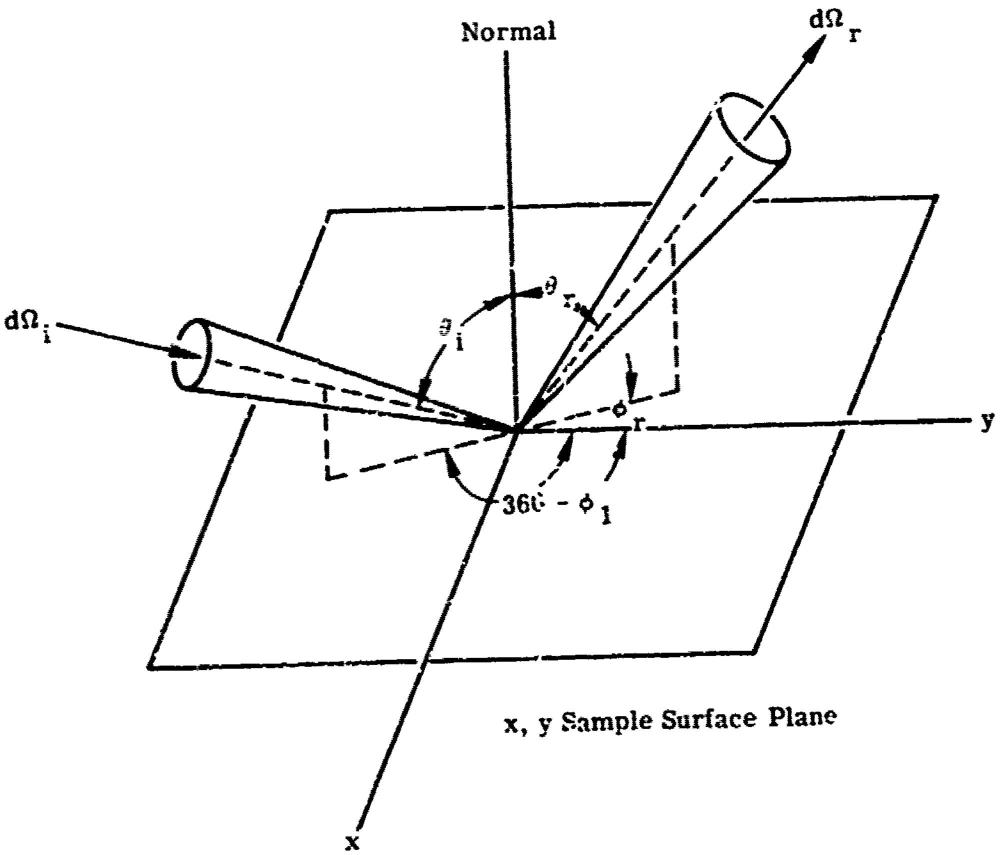


FIGURE 4 SPATIAL DISTRIBUTION OF INCIDENT (0.63 μm) AND REFLECTED RADIATION FROM A HELIOTEK SOLAR CELL



Directional Reflectance (ρ_d) Relationship to ρ'

$$\rho_d = \int_h \rho'(\phi_i, \vartheta_i; \phi_r, \vartheta_r) \cos \phi_x \, d\Omega_x$$

FIGURE 5. BIDIRECTIONAL REFLECTANCE (ρ') RELATIONSHIPS

All bidirectional data should be measured as a function of the linear polarization of the source and receiver. This is necessary because some sources are polarized, and significant differences in the distributions have been observed. These differences, evident in data presented in Appendices C and D, are predictable from the Fresnel equations for relatively smooth surfaces.

Measurements of $\rho'(\theta_i,\phi_r;\theta_i,\phi_i)$ for a variety of angular situations are required to fully characterize the distribution since the radiation source and receiver may assume any number of positions relative to the sample normal. Therefore, the plan must include sufficient measurements to allow evaluation of most situations that may be encountered. For a homogeneous diffuse material, in-plane and orthogonal plane detector scans at four or five source-incidence angles are adequate. These provide 40 data curves per sample for two source and receiver linear polarization combinations.

Another angular situation often encountered is the case where the source and receiver are coincident—i.e., the bistatic angle is small or zero. This is more common when an active source is used. For a homogeneous, specular material, a similar number of measurements can adequately describe the sample; however, the scan angles are closely incremented at azimuth and elevation angles near the specular reflections. Sample increments must be fine enough to resolve the specular structure. As part of the WRL/ERIM program, a scan matrix was developed which is useful in describing the specular characteristic; this matrix is discussed in Sections 2 and 4.

In the infrared portion of the spectrum, emittance is the quantity often used to describe the optical characteristics of a sample. The emittance of a material is a measure of how well that material emits radiant power in relation to a perfect emitter, called a blackbody, which emits the maximum possible radiant power at any given temperature.

Planck's law gives a description of blackbody radiation as a function of wavelength, λ[m], and absolute temperature, T[^{o}K]. The quantity treated here is called spectral emittance and denoted by $M_\lambda^b(T)$.* The Planck law for a spectral emittance is

$$M_\lambda^b(T) = 2\pi hc^2\lambda^{-5}\left[\exp\left(\frac{hc}{\lambda kT}\right)-1\right]^{-1} \text{[power/area-wavelength]} \qquad (3)$$

A real material emits less radiant power than a blackbody at the same temperature. A quantity, $\epsilon(\lambda, T)$, describes the effect; it is defined by

$$\epsilon(\lambda, T) = \frac{M_\lambda^e(T)}{M_\lambda^b(T)} < 1 \qquad (4)$$

*The subscript λ is used to indicate that the symbol bearing it has dimensions of "per unit wavelength." Otherwise, spectral dependence is indicated by treating λ as a function argument—e.g., $f(\lambda)$.

where $M_\lambda^e(T)$ is the actual spectral emittance of the real material at temperature T and $M_\lambda^b(T)$ is the (calculable) spectral emittance of a blackbody at the same temperature. This quantity, called the hemispherical spectral emittance, describes the relative emitting efficiency of a surface in radiating into the entire hemisphere above the surface.

The directional distribution of the radiation composing the spectral emittance of a blackbody is described by Lambert's law which states that the spectral intensity [power/wavelength-solid angle] emitted by a unit area of a blackbody in a direction normal to its surface is equal numerically to the hemispheric spectral emittance divided by π; that this radiation intensity decreases as cos θ_e at polar emission angles θ_e away from the surface normal; and that the radiation intensity is independent of the azimuth angle ϕ_e (see Fig. 6). Thus, the spectral radiance $L_\lambda^b(T;\ \theta_e,\ \phi_e)$ (power/area-wavelength-solid angle), which is the spectral intensity per projected area at polar angle θ_e and azimuth angle ϕ_e, is invariant with angle for a blackbody since the cos θ_e intensity dependence is exactly compensated by a 1/cos θ_e projected area dependence:

$$L_\lambda^b(T) = \frac{M_\lambda^b(T)}{\pi} \quad \text{for all } \theta_e,\ \phi_e \tag{5}$$

The use of projected area in L_λ^b and actual area in M_λ^b requires a factor of cos θ_e if radiance is integrated over the hemisphere to obtain emittance. That is,

$$M_\lambda^b(T) = \int_{\theta_e=0}^{\pi/2} \int_{\phi_e=0}^{2\pi} L_\lambda^b(T) \cos \theta_e \, d\Omega_e \tag{6}$$

in which $d\Omega_e = \sin \theta_e \, d\theta_e \, d\phi_e$ is the elemental solid angle.

A blackbody surface emits with unit efficiency not only into a hemisphere, but also into every direction in that hemisphere. Real materials do not have this property, so an angularly-variable spectral directional emittance, $\epsilon(\lambda,\ T;\ \theta_e,\phi_e)$, is defined for them:

$$\epsilon(\lambda, T;\ \theta_e,\phi_e) = \frac{L_\lambda^e(T;\ \theta_e,\phi_e)}{L_\lambda^b(T)} \tag{7}$$

where $L_\lambda^e(T;\ \theta_e,\phi_e)$ is the radiance of wavelength λ emitted from the material surface of temperature T in the direction (θ_e,ϕ_e).

The emittance of a material surface can be related to other optical properties of that surface. Kirchoff's law, based upon thermodynamic reasoning, states the equality of the emittance and absorptance of an opaque material in equilibrium with its environment. This law holds both for total hemispheric quantities and for spectral directional quantities. For the latter,

$$\epsilon(\lambda, T;\ \theta_e,\phi_e) = \alpha(\lambda, T;\ \theta_i = \theta_e,\ \phi_i = \phi_e) \tag{8}$$

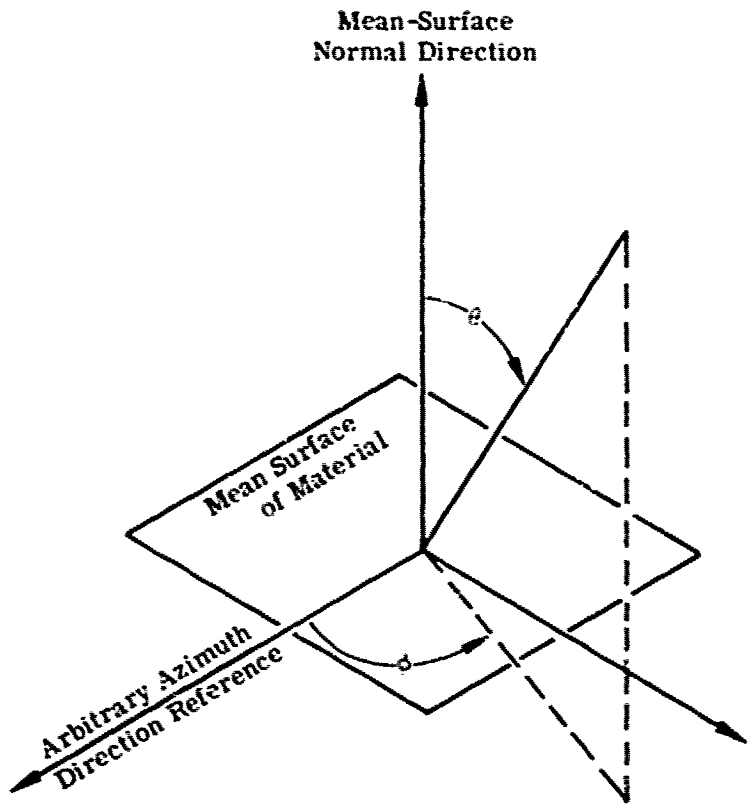


FIGURE 6. ANGULAR REPRESENTATION OF DIRECTIONAL EMISSIVITY

where $\alpha(\lambda,T;\ \theta_i,\phi_i)$ is the absorptance* for radiation of wavelength incident on the surface of temperature T at polar angle θ_i and azimuth angle ϕ_i. For an <u>opaque</u> material, conservation of energy requires that the absorptance and reflectance sum to unity if both quantities are evaluated at the same wavelength, temperature, angles, and polarization. Thus, it follows that

$$\epsilon(\lambda,T;\ \theta_e,\phi_e) = 1 - \rho(\lambda,T;\theta_i = \theta_e,\phi_i = \phi_e) = \alpha(\lambda,T;\ \theta_i,\phi_i) \tag{9}$$

where $\rho(\lambda,T;\ \theta_i,\phi_i)$ is the spectral directional hemispheric reflectance** of the material surface of temperature T, for radiation of wavelength λ incident at polar angle θ_i and azimuth ϕ_i. This relationship is independent of surface character, layering of different materials, etc., as long as the total ensemble of materials forming the target is opaque and in strict thermal equilibrium with its environment.

Using the equation presented above, it is obvious that a measurement of the spectral directional emittance† (often referred to as ϵ_d) is essentially equivalent to measuring the spectral directional reflectance (ρ_d) for the conditions mentioned above.

During any reflectance or emissivity measurements, special attention must be given to the interpretation of data when the materials measured are not opaque. In these cases, materials of known reflectances must be used behind the samples, and additional processing used to isolate the measured data. Conversely, when these data are used for future analysis, corrections must be made for the backing materials used. Plainly, judicious choices of samples and sample composition can avoid unnecessary complications.

Since both the reflectance and emittance spatial properties are strong functions of the surface properties, any program undertaking these measurements should carefully measure the surface conditions—i.e., the RMS surface roughness and other parameters. Microphotographs of representative areas can be useful. Thus in any comparative analysis it becomes necessary to show that the surfaces used are essentially the same as those measured. Often materials possessing the same generic name have quite different surface properties (e.g., roughness, heat treatment, etc.). Therefore pertinent physical and chemical properties should be determined and recorded to ensure proper utilization of the measured optical properties.

*The temperature-dependence of absorptance and reflectance is often ignored in the literature. Generally, it should not be.

**Simply the fraction of the radiant power incident on a surface from the direction (θ_i,ϕ_i) which is reflected (into all directions) by the surface.

†The term emittance is used to describe the emitting efficiency of an arbitrary surface. At ERIM, the term "emissivity" is reserved specifically for describing the efficiency of a pure substance with a perfectly flat surface and of sufficient thickness to be completely opaque. All materials presented in this report conform to the above conditions; therefore, the terms emittance and emissivity may be used interchangeably.

In general, the problems associated with any comparative analysis were avoided by duplicating actual material preparations. All samples measured were provided by the Sponsor (SAMSO) through the manufacturer of the actual vehicle and/or surface materials. As specified at the time, all surface and substrate materials were required to be the same as on flight vehicles and acceptable for flight use. In addition, all surface preparation and assembly technique employed on the actual vehicle were to be used on components.

Sample materials of interest to the effort had been given a cursory examination by Aerospace Corporation and some samples were found to have rather unique and unusual properties [1]. Therefore, at the beginning of the program, it was necessary to conduct some preliminary experimentation before finalizing the measurement plan and commencing measurements. This preliminary experimentation and its results are discussed in the next section and followed in Section 3 by a discussion of the measurement program and sample selection. The instrumentation is described and data processing techniques discussed in Section 4 together with samples of the data. In Section 5 data interpretation is discussed and the unique properties of particular samples which have been observed are presented. Inter-relationships of the data and its variability for selected materials are shown.

All pertinent data resulting from the measurement program and collected from other sources are presented in Appendices A through E. In Appendix F we summarize the ERAS data format which has been used for data logging. ERAS formats have been used to assemble and store all of the ρ_d, ρ' diffuse, and ρ' fixed bistatic data in a form whereby selected retrieval and/or computer processing can be readily implemented. A master copy of all the data has been retained in the ERIM Library for future use as requested by SAMSO.

1. Rawcliffe, R., Reflectance of Solar Cells, Report No. TOR-0172(2322)-2. Aerospace Corp., 15 March 1972.

2
PRELIMINARY INVESTIGATIONS

Although various types of laboratory measurements may be logically defined to characterize the radiative properties of materials, the execution of the corresponding physical measurements with existing laboratory apparatus requires preliminary experimentation with actual samples. The experimentation will ascertain the limits placed on the apparatus and match the measurement routines to the measurement requirements of the various sample types. Real equipment has limits of dynamic range, spatial and spectral resolution, and a finite accuracy, while the logical definitions of radiometric properties imply use of ideal equipment. In addition, real measurements have finite costs and time limitations so that the total number and the complexity of experimental operations must be constrained to those sufficient to acquire realistic and representative data for the task. Specific problems addressed in the preliminary investigations were:

(1) Measurement of samples having a high degree of specularity
(2) Exoatmospheric simulation of the solar source
(3) Sample preparation and selection

2.1. THE SPECULARITY PROBLEM

The prime measurement problem, made manifest by preliminary experimentation, was the problem posed by the high degree of specularity of the solar cells, the second surface mirrors, and the metalized mylar. The high specularity required that two issues be dealt with: first, the bidirectional reflectance values varied by several orders of magnitude: and second, the required spatial resolution changed radically, from the non-specular to the specular orientation of the sample. Consequently, two separate measurement routines became necessary. To resolve the dynamic range and resolution issues, the reflectance distribution function (ρ') was divided into two additive components, the specular lobe and the slowly spatially-varying diffuse lobe. Because a significant fraction of the reflected flux appeared in the specular lobe, the properties of the specular lobe were of major importance.

A visual inspection of the sample materials also revealed that the angular distribution of flux from such components in the far field of the specular lobe could not be calculated. Dr. Rawcliffe, at Aerospace, provided pictorial evidence that the angular distribution of flux in the near field would significantly differ from that in the far field [2]. Subsequent measurements at ERIM confirmed Rawcliffe's measurements. Therefore, it was necessary to create optical far-field measurement conditions to obtain realistic data for the specular reflection component. This far-field measurement condition was implemented by intercepting the specular flux with a large objective lens and then measuring the incident flux at a position one focal

2. Rawcliffe, R., Aerospace Corp., El Segundo, Calif., Letter Communication to M. Bair, Willow Run Laboratories, July 1972.

length behind the objective (the far field — focussed at infinity). A large-aperture objective was used in order to measure flux on the optic axis with the goniometer detector and the off-axis flux with photographic film on which the fine structure of the far field pattern is recorded. The acceptance angle (α) of the receiver was determined by the detector aperture according to

$$\alpha = \frac{d}{f} \tag{10}$$

where d = diameter of the detector aperture

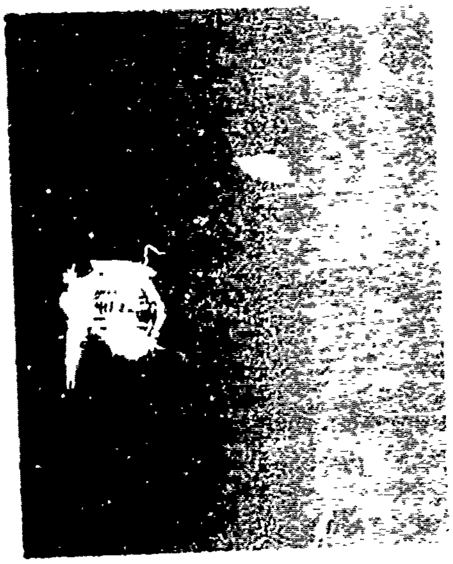
f = focal length of the objective

The minimum value of d is determined by the Rayleigh criteria and or other limiting performance characteristics of the particular objective being used.

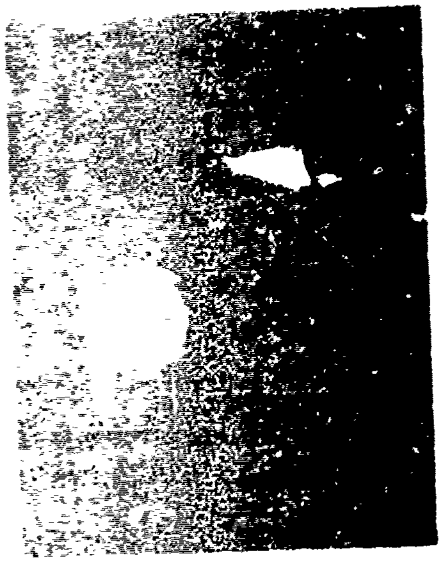
Under coherent illumination, the far-field specular lobe of these components consisted of interference patterns having various degrees of fine structure. This is illustrated by a qualitative comparison, in Fig. 7, of the far-field reflection from a single solar cell using coherent radiation at 0.63 μm and noncoherent illumination (0.4-0.7 μm). It was determined, after consultation with AVCO and SAMSO, that recording of the completely resolved pattern of the coherent components would produce a volume of data well beyond the current requirements for the modeling task being carried out by AVCO. Therefore, the pattern was scanned in raster fashion by the goniometer receiver with an aperture of sufficient size to provide analog smoothing of the fine structure and to record the pattern in a reflectance matrix 9 columns wide and having 11 elements per column.

Further data reduction was performed when it was determined by AVCO that a good representation of the data matrix could be obtained through a bull's-eye (see Section 5.1.1) representation consisting of 5 or 6 data points. The far-field pattern, caused by the chance superposition of the specular lobes of two separate components on the same panel, was expected to exhibit an additional interference effect because of the coherent interaction of flux from the two components. However, since the spacing of the interference fringes must vary inversely with the separation of the sources producing the interference, the additional interference was expected to be even more fine in structure than that for a single component.

The fine structure of a single component was not expected to be resolved by the remote sensing apparatus being used; the modeling of two components on the same panel was successfully accomplished simply by appropriate superposition of the separate 99-element arrays derived from the intensity distributions or, depending on sensor resolution, by an overlap of the bull's-eye data. The expected amount of lobe overlap may be obtained from the measurements statistics obtained for the angular distribution of the effective specular plane normals of components on a flat panel.



(a) Source, ...
LT8, Ex...



[illegible] ...ation.
...sec.

FIGURE 7 (CONT) ... A SINGLE C-
TYPE SOLAR ... m- RA-

One class of solar cell had two specular plane normals. one probably a reflection from the cover glass, and the other from the silicon wafer. This assessment is made on the basis of the color (spectral) character of the two specular reflections being observed with white light illumination. These cells which exhibit two independent specular returns require that a 99-element matrix of each return be measured in order to characterize the specular components.

2.2. THE SOLAR SIMULATION PROBLEM

Reflectance measurements of a source irradiance simulation of the exoatmospheric solar spectrum covering the 0.4 to 0.7 μm, visible, bandpass were required. The large ultraviolet component of sunlight outside the earth's atmosphere required a source which produced an unusual amount of ultraviolet radiation.

The xenon lamp was chosen as the most suitable of possible sources for solar simulation. High-temperature tungsten lamps operate at a relatively low color temperature (2850 to 3200°K). Too little ultraviolet radiation is produced in the 300- to 375-mm range for practical use. Carbon arc lamps produce copious ultraviolet radiation, but here it arises from line spectra in the flame of the carbon arc. The carbon electrode blackbody radiation has a color temperature of about 3850°K. The carbon arc is difficult to stabilize, and suitable filters to moderate the ultraviolet line spectrum for solar simulation are not known.

A preliminary investigation indicated that a combination of the xenon arc lamp and two glass filters, Corning No. 3965 and U-0793A, would produce a spectrum resembling the exoatmospheric sunlight spectrum published by NASA [3]. The relative spectral intensity of the xenon lamp plus filters was measured with the Beckman DK-II spectrophotometer and a 2850°K tungsten lamp as the reference standard. The relative spectral intensity spectrum obtained is compared with that of the exoatmospheric NASA solar spectrum in Fig. 8. A relatively good simulation was obtained across the major responsivity spectrum of the S-20 photocathode. Maximum departure occurs in the UV spectrum below 0.375 μm, as would be expected. The error imparted by this mismatch can be readily evaluated. Evaluation is accomplished by comparing the broadband reflectance values of a solar cell illuminated first with the sun and then with the simulation source. In both cases the spectral responsivity of the S-20 photocathode is assumed. Thus, for the comparison, the following relationships are evaluated using the spectral reflectance (ρ_d) measured on the Beckman DK-II:

$$\rho_d(\text{cell, sun}) = \frac{\int R(\lambda, \text{S-20})\rho_d(\lambda, \text{cell})E_\lambda(\text{sun})d_\lambda}{\int R(\lambda, \text{S-20})E_\lambda(\text{sun})d_\lambda} \qquad (1[illegible])$$

3. Thekaelara, M., Evaluating the Light from the Sun, Optical Spectra, March 1972, p. 320.

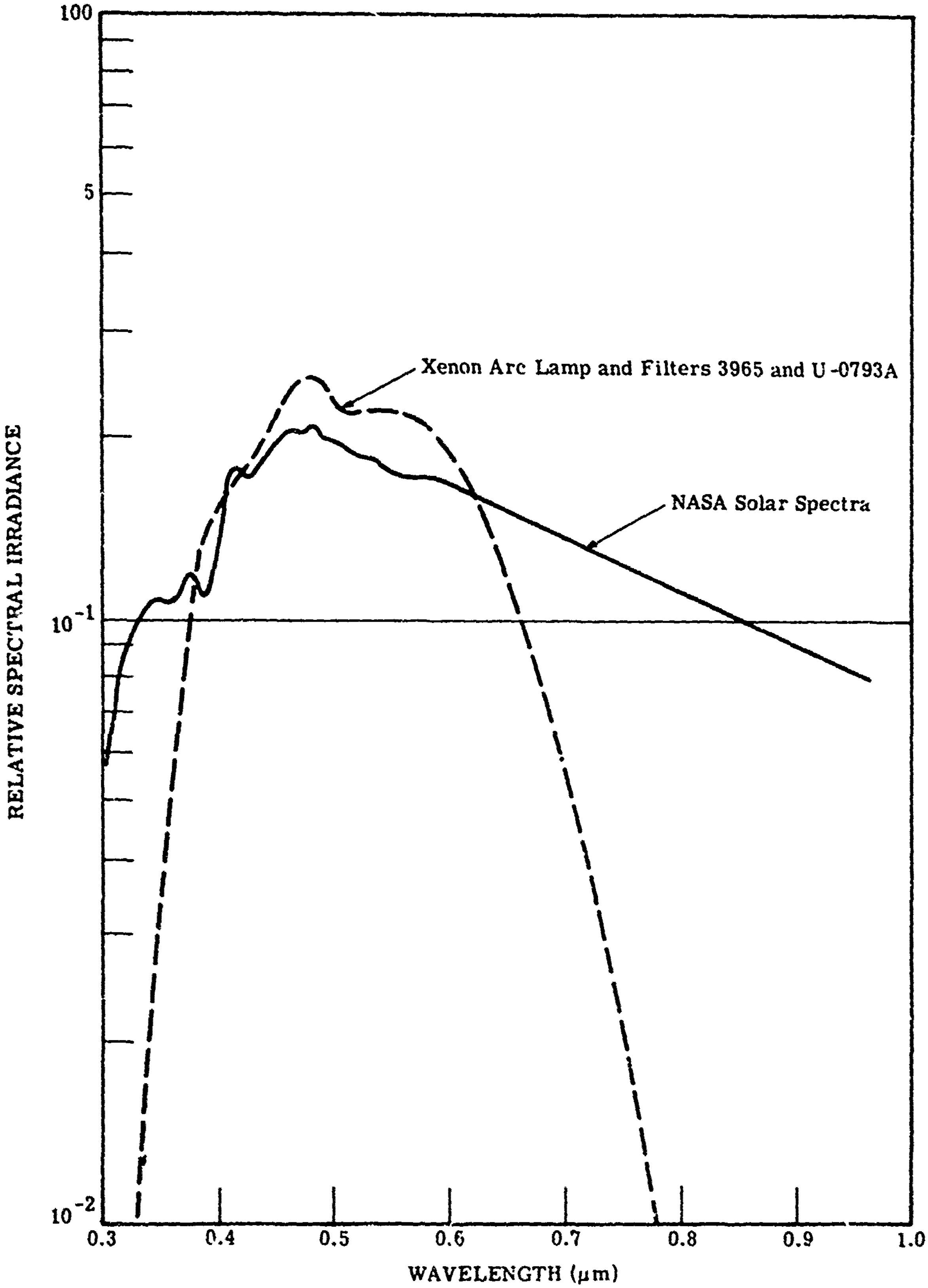


FIGURE 8. EXOATMOSPHERIC SOLAR SIMULATION IN THE 0.4- to 0.7-μm BANDPASS

and

$$\rho_d(\text{cell, sim}) = \frac{\int R(\lambda, \text{S-20})\rho_d(\lambda, \text{cell})E_\lambda(\text{sim})d_\lambda}{\int R(\lambda, \text{S-20})E_\lambda(\text{sim})d_\lambda} \tag{12}$$

where ρ(cell, sun) = broadband reflectance resulting from sunlight in the S-20 spectral range

R(λ, S-20) - spectral responsivity of the S-20 photo emissive tube read from an RCA chart

E_λ(sun) = exo-atmospheric spectral irradiance of the sun taken from NASA tables

E_λ(sim) = relative spectral irradiance of the simulated sunlight—the xenon lamp and two filters

ρ(cell, sim) = broadband reflectance due to simulated sunlight in the S-20 spectral range

For good simulation, these two values of broadband reflectance, ρ(cell, sun) and ρ(cell, sim), should be approximately the same. Results of the calculations were

ρ(cell, sun) = 0.227

and

ρ(cell, sim) = 0.213

The fact that these two values are in reasonable agreement (within 10%) indicates that the simulation yields results within the accuracy expected of many broadband radiometric measurements. Therefore, the simulation was considered adequate. This result is of particular importance because the total reflectance is heavily weighted in the UV due to the reflectance characteristics of the solar cells (see Appendix B).

During the preliminary investigations, data comparison for solar illumination with the scotopic and photopic eye responsivity were anticipated because much data had been reported earlier in stellar magnitudes. It was determined that both receiver responsivities could be obtained with standard Corning filters over commercially available detectors. The responsivity matches obtained are shown in Figs. 9 and 10 for both the scotopic and photopic eye. Neither of these systems were utilized during data collection but are included for future reference.

2.3. THE SAMPLE SELECTION PROBLEM

Sample selection and construction were initiated early in the program following discussions at SAMSO. All samples were prepared by the same contractors who prepared and assembled the flight hardware. Solar cells, second surface mirrors, and painted surfaces

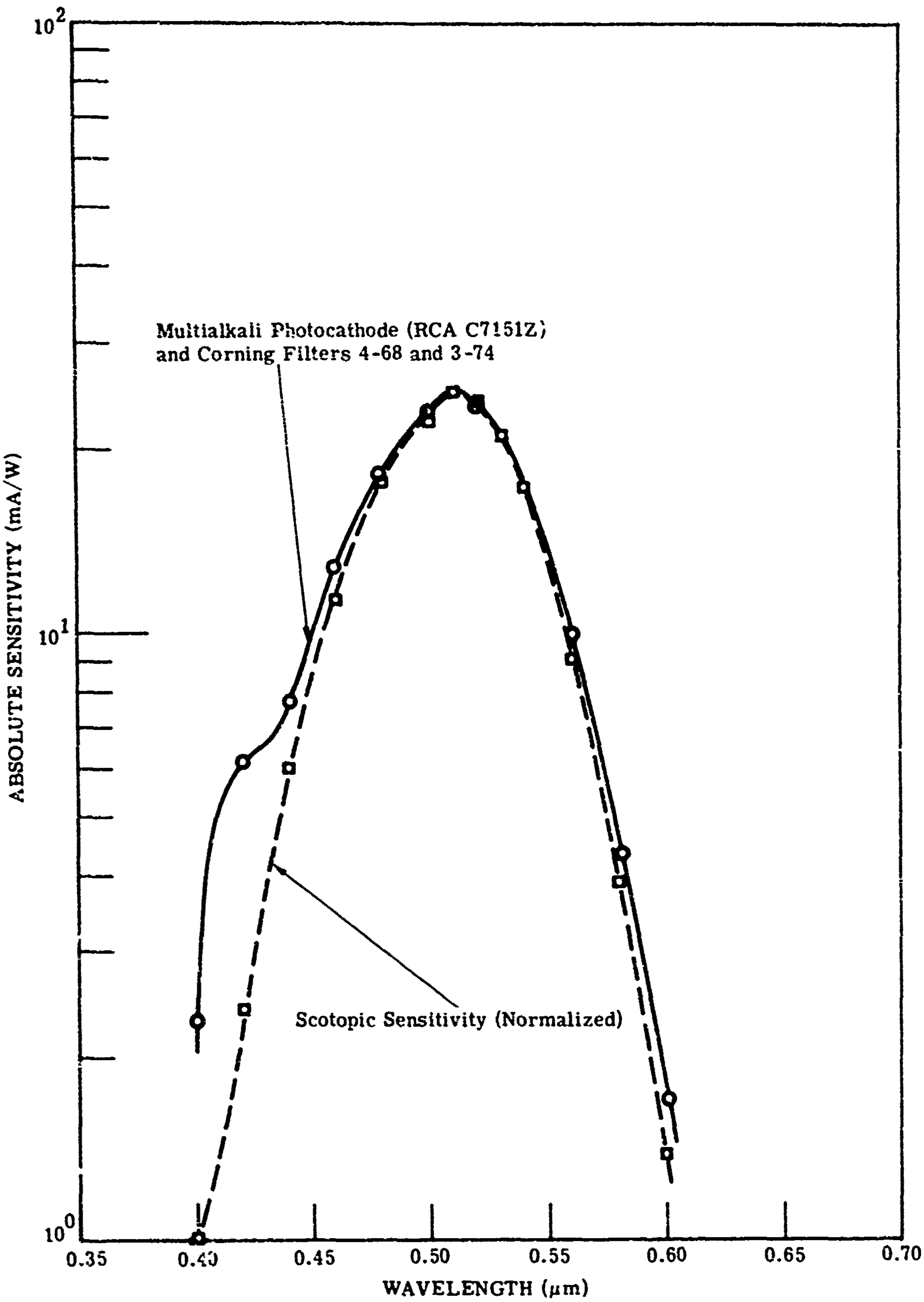


FIGURE 9. SCOTOPIC EYE RECEIVER SIMULATION. Multialkali photocathode with Corning filters 4-68 and 3-74.

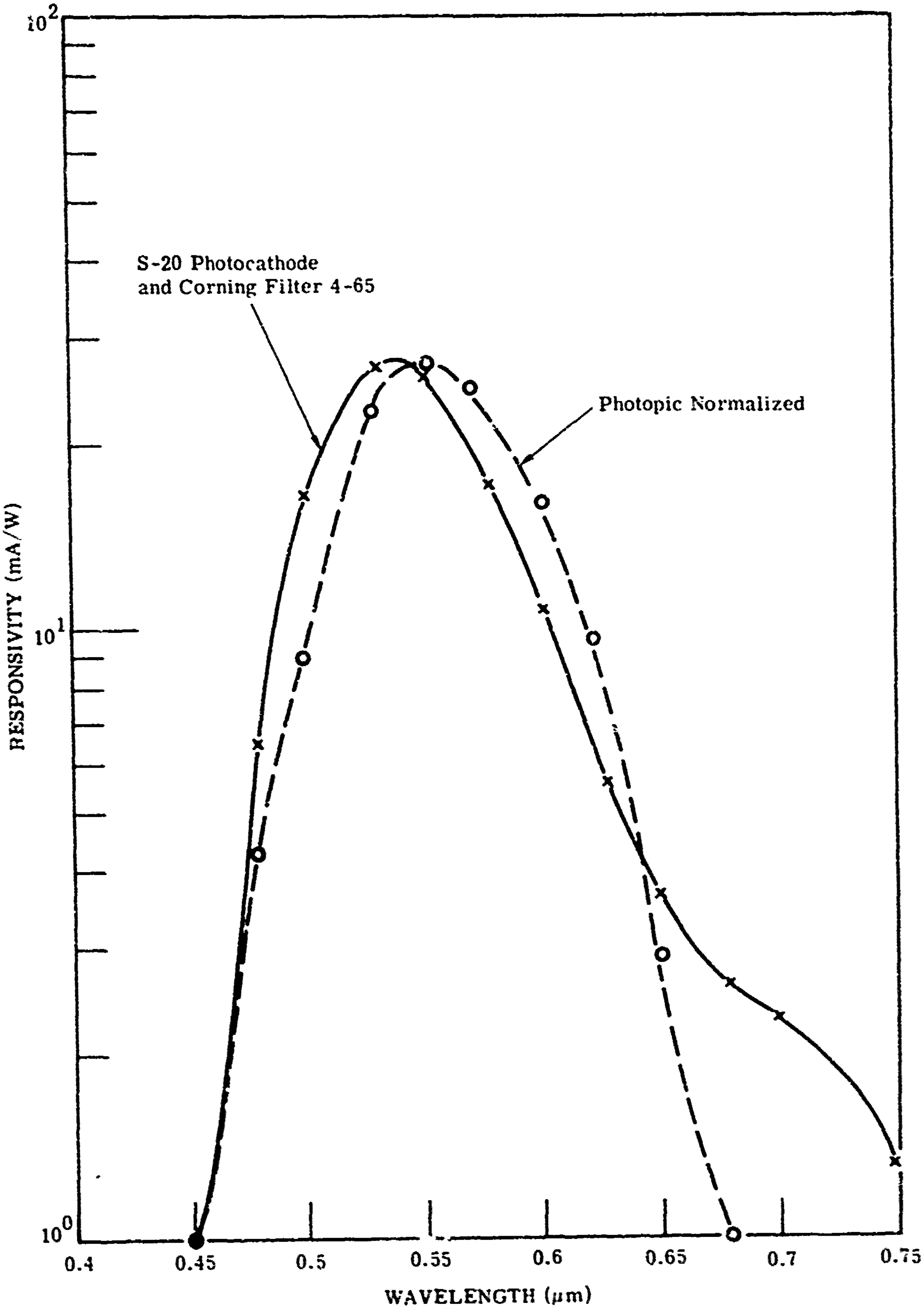


FIGURE 10. PHOTOPIC EYE RECEIVER SIMULATION. S-20 photocathode with Corning filter 4-65.

were to be constructed from components and materials used in actual flight hardware. All materials were to be mounted on the same substrate framework being used on actual flight equipment. Samples of all substrate and hardware components were included in the sample selection. Sample acquisition was carried out by SAMSO in agreement with contractual arrangements with only two exceptions. In the case of the thermal trim tape and aluminized mylar, samples of the materials were provided from the flight hardware assembly shops at Aerojet and TRW Systems. ERIM constructed representative sample substrates.

The samples of trim tape were readily assembled since, in flight hardware, the aluminized tape is randomly applied to the thermal control mirrors. As such, the tape was applied to glass cover slides attached to an aluminum plate to simulate the flight hardware.

The samples of metalized mylar were highly specular and, consequently, the specular measurement routine which was planned for metalized mylar was similar to that for the second surface mirrors. Although metalized mylar did not have a segmented structure, the placement of a mask over a representative selection of areas provided the statistical properties of a complete panel of mylar. With preliminary experimentation it became clear that the surface properties affecting the specular lobes and surface normals depended greatly upon the manner of mounting of the mylar. Stretching the mylar produced non-random undulations in the surface. The direction of undulations depended upon the direction of maximum stress. Consequently, no significant specular lobe measurement could be made on this material without knowledge of the specific mounting techniques. Metalized mylar sample preparation proved to be rather difficult and eventually was eliminated from the measurement plan.

3
MEASUREMENT PLAN

The measurement plan was developed to provide data on the spectral and spatial reflectance properties as well as on the variance of those properties for satellite surface materials of interest. Particular emphasis was placed upon ensuring that the data were applicable to the satellite modeling tasks being carried out by AVCO. Necessarily, the plan was altered several times to permit re-direction of measurement emphasis as data results on specific materials dictated. The plan logically comprised three tasks. The first dealt with sample selection and fabrication. The second was concerned with those measurements required to define the mean value and standard deviation of the spectral reflectance or emittance of the satellite surface materials. The third task was designed to give a measure of the mean and variance of the spatial distribution of the radiation.

Scope of the plan was necessarily limited in order to keep within a limited time frame and budget. The plan was so designed that first-order spectral and spatial information could be extracted from the data over the spectral range extending from the ultraviolet (0.24 μm) to the far IR (22 μm). Also, it tends to emphasize those wavelengths and materials currently of prime interest to the sponsor.

3.1. SAMPLE SELECTION AND PREPARATION

Much effort went into selection and preparation of the samples measured because seemingly unimportant differences between two samples can cause their reflectance properties to vary significantly. Thus, great care was taken in preparing the samples measured to assure that they were in every way identical to the materials used in actual satellites. In fact, all samples were made of the same materials and substrates as used on satellites. Where such materials might be supplied by two different vendors—as was the case for the solar cells and second-surface thermal control mirrors—samples from both vendors were measured. The samples were assembled following the same procedures used in the construction of satellites and, in fact, were assembled by the satellite contractors. (All samples were acquired by SAMSO from their contractors.) As the samples arrived at ERIM, each was entered in our master log and assigned a control number. These samples are listed and described in Table 1.

3.2. SPECTRAL CHARACTERISTICS

The spectral character of the opaque materials listed in Table 1 can be readily determined by measuring either the directional reflectance (ρ_d) and/or directional emittance (ϵ_d). The relationship of these two quantities, discussed earlier, is as given in Eq. (9). Sponsor requirements dictated that emphasis be placed on the visible to near-infrared spectrum. Thus, the measurement plan for determining the spectral character of materials has emphasized the spectral region extending from 0.24 to 2.6 μm. In this spectral region, sufficient data are

TABLE 1. SAMPLE DESCRIPTION

Sample	Description	Substrate
3157	3-mil Aluminized Mylar	Aluminum
3158	Thermal Control Mirrors, 2nd Surface	Honeycombed Aluminum
3159	Aluminized Reflectance Tape	Aluminum
3160	Thermal Control Blanket Material	
3161	Fiberglass Honeycomb Aluminum	
3162	Tape from #3159 Applied to Glass Cover Slide (thermal trim tape)	Aluminum
3163	Tape from #3159 Applied to Glass Cover Slide (thermal trim tape)	Aluminum
3164	Tape from #3159 Applied to Glass Cover Slide (thermal trim tape)	Aluminum
3165	Thermal Control Mirrors Mounted on Equipment Door. Door is Double Aluminum with Al Honeycomb Separation.	
3177	Aluminized Reflectance Tape	Black Anodized Aluminum
3178	H-Type Solar Cell	Fiberglass Honeycomb
3179	H-Type Solar Cell	Fiberglass Honeycomb
3180	C-Type Solar Cell	Fiberglass Honeycomb
3181	C-Type Solar Cell	Fiberglass Honeycomb
3182	H-Type Solar Cell	Aluminum Honeycomb
3183	H-Type Solar Cell	Aluminum Honeycomb
3184	C-Type Solar Cell	Aluminum Honeycomb
3185	C-Type Solar Cell	Aluminum Honeycomb
3186	H-Type Solar Cell	Aluminum Honeycomb
3187	C-Type Solar Cell	Aluminum Honeycomb
3188	Solar Cell	Fiberglass Honeycomb
3189	Second-Surface Mirrors	RTV 566 with Mg Backing
3190	Second-Surface Mirrors	RTV 566 with Mg Backing
3191	Second-Surface Mirrors	RTV 566 with Fiberglass Backing
3192	Second-Surface Mirrors	RTV 566 with Fiberglass Backing
3193	Second-Surface Mirrors	RTV 566 with Fiberglass Backing
3194	Second-Surface Mirrors	RTV 615 with Fiberglass Backing
3195	Second-Surface Mirrors	RTV 615 with Fiberglass Backing
3196	Second-Surface Mirrors	RTV 615 with Fiberglass Backing
3197	Black Velvet Paint	Mg
3198	Black Velvet Paint	Mg
3199	Black Velvet Paint	Mg
3200	Second-Surface Mirror	RTV 615 with Mg Backing
3201	Second-Surface Mirror	RTV 615 with Mg Backing
3202	Second-Surface Mirror	RTV 615 with Mg Backing
3203	White Paint Panel	Mg
3204	White Paint Panel	Mg
3205	White Paint Panel	Mg
3206	White Paint Panel	Mg
3207	White Paint Panel	Mg
3208	White Paint Panel	Mg
3209	White Paint Panel	Mg
3212	3M Black Velvet Paint	
3213	Second-Surface Mirror	
3214	Solar Cell	
3215	White Paint	
3216	White Thermal Control Paint	

available for each material to precisely determine the mean and standard deviation of each material selected. Differences relating to manufacturer were also a prime consideration.

For the infrared spectrum, because of time and fund limitations, only one or two data curves for each type material were measured (or acquired from other laboratories). These, of course, while not allowing one to determine a mean or standard deviation, permit a first-order evaluation of the material characteristic. The initial plan provided for collection of directional emissivity data as a function of sensor viewing angle and temperature. Subsequently, a data search revealed that pertinent data were available from TRW Systems, Illinois Institute of Technology (IITRI), and the ERIM Target Signature Analysis Center (TSAC). With this data, a first-order characterization of the principal sample materials could be obtained. Therefore, in keeping with program emphasis, these data were utilized to satisfy program requirements.

A description of the spectral measurement instrumentation can be found in Section 4; measured data are contained in Appendix B.

3.3. SPATIAL CHARACTERISTICS

The spatial distribution of radiation emanating from sample materials being measured was caused by two distinctly different effects. One, the bidirectional reflectance (ρ'), is strictly a function of the materials making up the sample surface. The other effect, which determines spatial distribution, is the orientation of the direction normal for individual elements making up the sample surface.

The direction normal becomes particularly important in the case of samples comprised of elements that tend to be specular—e.g., the solar cell and second-surface mirrors being measured on this effort. But for sample materials having a diffuse character, the direction normal is not significant. Thus, the measurements required to adequately describe the spatial distribution of the various materials will differ, and the samples measured may be logically separated into two categories: those which are "diffuse" and those which are "specular."

The bidirectional reflectance measurements were made with the source and receiver polarization and the wavelength of the source as parameters. The wavelengths were chosen to emphasize the visible to near-IR spectrum and such that extrapolation and interpolation techniques could be used to provide first-order data at other than the measured wavelengths. We used the laser wavelengths of 0.63 μm, 1.06 μm, and 10.6 μm, and one incoherent broadband source in the visible to simulate solar radiation in the 0.4- to 0.7-μm spectrum. Both source and receiver were polarized for all of the laser wavelengths, but only the receiver was polarized in the incoherent band. This approach simulates realistic cases which might be encountered.

The following sections give a more detailed description of the measurements plan rationale.

3.3.1. DIRECTIONAL NORMAL MEASUREMENTS

The specular samples were constructed of individual cells or mirrors mounted by hand to a substrate. The effect of such construction is that each element reflects an incident beam of light in a slightly different direction. Fig. 11(b) is an illustration of what happens when an array of mirrors is illuminated by a collimated beam of light. The measurement problem is evident. Nevertheless, a technique was developed by which the deviation of each element's direction normal from the substrate's direction normal could be measured. The statistics thus obtained were of course essential in determining the radiation energy distribution of the samples composed of specular elements.

3.3.2. ρ' SPECULAR MEASUREMENTS

The directional normal measurement determines where, in space, the element puts its specularly reflected component in relation to the substrate normal, but does not give any information about the bidirectional reflectance of that element. Following preliminary experimentation, it was decided that a 99-element (9 × 11) measurement matrix would provide the desired bidirectional reflectance spatial contour for the solar cells and second-surface mirrors. These measurements were confined to a small solid angle surrounding the specular angle and are subsequently referred to as the specular ρ' measurements.

The $1.0^{\circ} \times 0.9^{\circ}$ measurement matrix consisted of a set of 99 points taken at 0.1 deg increments using a 0.2 deg aperture, or a $2.0^{\circ} \times 1.8^{\circ}$ matrix taken at 0.2 deg increments using a 0.4 deg aperture. The smaller matrix is preferred, while the larger one is used only when necessary to cover the extent of the specular reflection.

Hardware modifications to the gonioreflectometer were necessary to permit all matrix measurements to be made in the far-field at the laser wavelengths of 0.63 μm and 1.06 μm, and for the incoherent white light source. Because hardware are not available for similar modifications in the IR band, the 10.6 μm plan was necessarily different (see Section 3.3.4). Following initial tests by AVCO, the 99-point matrix was further manipulated to form a bull's-eye representation of the matrix (for which circular symmetry of the reflection was assumed). The primary purpose of the bull's-eye representation was to reduce the number of data points to a more manageable number.

Matrix measurements were designed to obtain the mean and standard deviation of sample elements (solar cells and second-surface mirrors) having specular reflection. Multiple samples were selected for all component manufacturers, and at least three elements per sample were measured. The matrix of each element of each sample was measured at source incidence angles of 5, 20, 40, and 60 degrees, respectively. These measurements are adequate for all elements having azimuthal symmetry, such as the mirrors. However, for the solar cells, a visual check quickly showed that additional measurements are necessary since azimuthal symmetry does not exist. Therefore, the matrix measurements described above were carried out at two azimuth

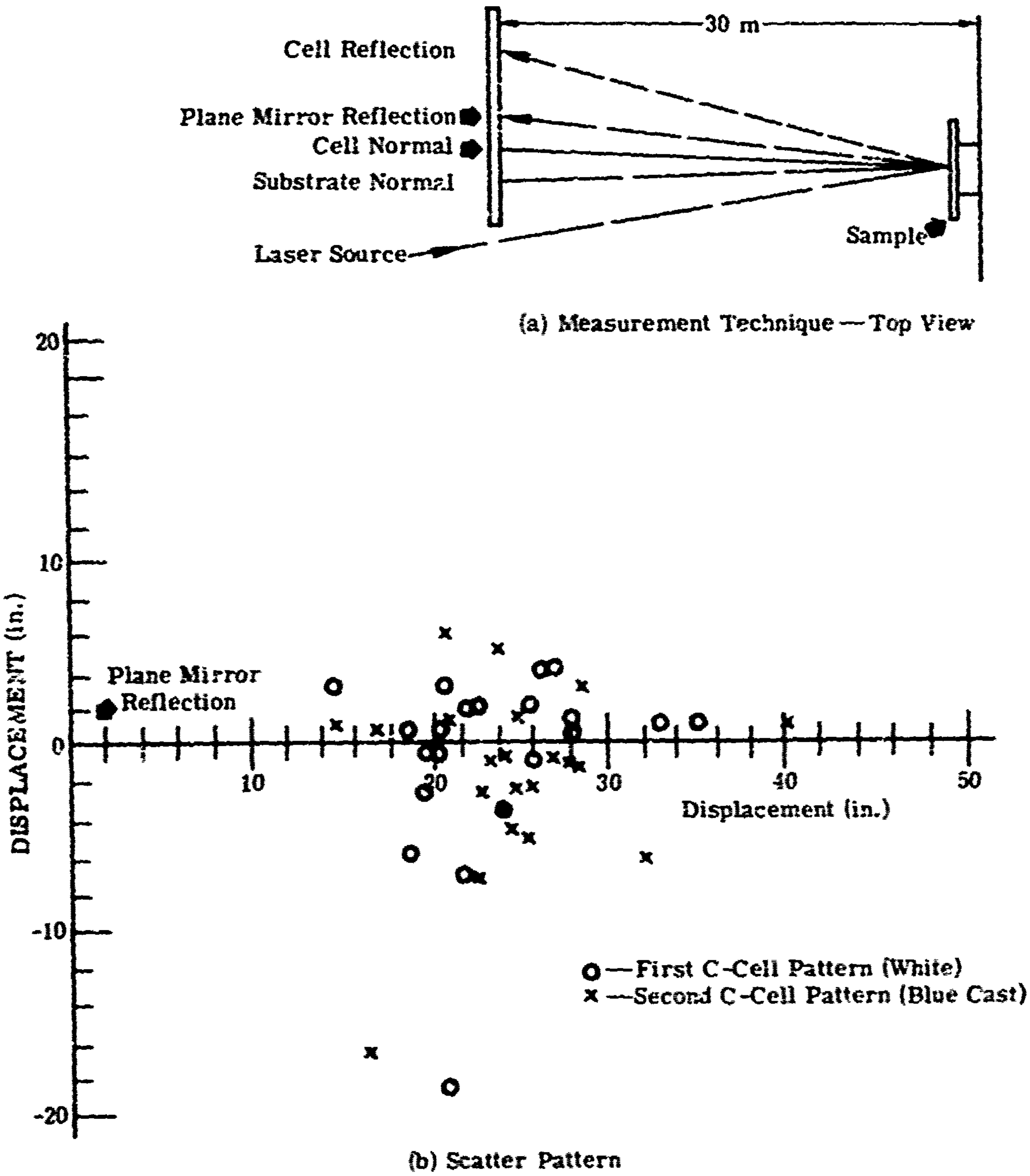


FIGURE 11. SCATTER DIAGRAM OF INDIVIDUAL CELL REFLECTANCE (SAMPLE 3185)

planes (θ_i) for each solar cell element. Planes of 0 to 180^o and 90-270^o were used to describe the extreme conditions. (Note: All matrix measurements were carried out with linear polarization of the source and receiver as a parameter.)

3.3.3. ρ' DIFFUSE MEASUREMENTS

The direction normal and matrix measurements describe the specular bidirectional reflectance of each element on the solar cell and second-surface mirror arrays. It is also important to know the magnitude of the diffuse component and the reflectance contribution from the intersections and junctions of the individual elements. This information is obtained by illuminating the junction between four adjacent elements as well as portions of the elements, and then measuring the scattered radiation. Such measurement is referred to as a diffuse ρ' measurement and can be performed with currently configured hardware.

Diffuse reflectance measurements were carried out on one junction of each sample measured in Section 3.3.2, at source incidence angles of 0 to 40^o. The angles were limited, because if indeed the reflection is approximately diffuse, the Lambertian distribution may be applied and data extrapolated to other angles. This diffuse ρ' data can then be combined with the specular ρ' matrix data to obtain a complete polarized reflectance function for the solar cells and second-surface mirrors.

Bidirectional reflectance measurements were also made on all other samples classified as diffuse—i.e., having no significant specular component. These measurements were at the laser wavelengths of 0.63 μm and 1.06 μm and also with the incoherent broadband visible solar source with linear polarization of the source and receiver as a parameter. Source incidence angles were set at 20, 40, and 60 degrees with the receiver being scanned both in 0 degrees and 90 degrees out of the incident plane. Measurements were also made at 0 degree incidence with the receiver scanning the 0-180 azimuth plane of the sample. Plots of the ρ' measurements made on the diffuse samples as well as of the ρ' diffuse measurements made on the specular samples appear in Appendix C.

3.3.4. MONOSTATIC REFLECTIONS AT 10.6 μm

Hardware limitations required the measurements plan at 10.6 μm to be somewhat different than at other wavelengths. The polarized source and receiver were arranged in a fixed bistatic (essentially monostatic—β = 0.26^o) configuration. The sample element was then placed in the far field of the source and rotated through 180^o while the reflected radiation was monitored.

Samples for these measurements were selected as discussed in prior sections—a minimum of three elements on each sample being measured such that the mean and standard deviation could be obtained. Checks are to be made on the azimuthal dependence; however, measurements in one plane should be adequate since azimuthal symmetry on all samples is expected. (Note: Solar cells are covered with a quartz plate which should have no azimuthal dependence as observed in the visible range.)

In general, the measurements will be useful for applications where polarized or unpolarized monostatic conditions occur. Because these measurements were made in the ERIM dark tunnel, they are often referred to as the "tunnel" or 10.6 μm tunnel measurements. The measurement setup is detailed in Section 4. Appendix E contains a tabulation of the measured data.

3.4. MEASUREMENT PLAN SUMMARY

The measurement plan discussed in preceding sections is presented in Table 2. Data resulting from this plan provides the sponsor with basic quantitative information with which to describe the optical characteristics of selected satellite surface materials over the 0.4- to 22-μm spectrum. Spatial distribution information $\rho'(\lambda_o)$ at selected wavelengths (λ_o) is presented which can be extended to other wavelengths by changing the magnitude according to the relationship

$$\rho'_{(\lambda_N)} = \rho'_{(\lambda_o)} \frac{\rho_d(\lambda_N)}{\rho_d(\lambda_o)} \tag{13}$$

This approach is generally applicable to conditions where the ratios of $[\rho_d(\lambda_N)]$ $[\rho_d(\lambda_o)]$ = 1.0 ± 0.1. This "rule of thumb" has been used successfully in similar applications; however, exceptions have been found so some caution should be exercised in its application.

TABLE 2. MEASUREMENT PLAN SUMMARY

(The tabulation indicates the number of areas measured under each condition.)

Sample No.	ρ_d	Direction Normal	ρ' SPECULAR 0.4-0.7 μm	ρ' SPECULAR 0.63 μm	ρ' SPECULAR 1.06 μm	ρ' DIFFUSE 0.4-0.7 μm	ρ' DIFFUSE 0.63 μm	ρ' DIFFUSE 1.06 μm	10.6 μm
3165	7		3	3	3	1	1	1	3
3177	1					1	1	1	2
3178	3	36							
3179	3	36	3			1			3
3180	3	36							
3180*		36							
3181	3	36	3			1			3
3181'		36	3						3
3182	3	36	3	3	3	1	1	1	3
3183	3	36	3			1			3
3184	3	36	3	3	3	1	1	1	3
3184'		36	3	3	3				
3185	3	36	3			1			3
3185'		36	3						
3186	3	108							
3187	3	108							
3187'		108							
3189		80							3
3190	3	80	3	3	3	1	1	1	3
3191		80							
3192	3	80							
3193		80							
3194	3	80	3			1			3
3195		80							
3196		80							
3197	2					1			1
3198	2								
3200	3	80							
3201		80							
3202		80							
3206	2					1			1
3207	2					1	1	1	1
3209	2								

*This is the second reflection from the C-Type cell which has a blue cast when illuminated by white light.

4
INSTRUMENTATION AND DATA PROCESSING

4.1. DIRECTION NORMAL MEASUREMENTS

The solar cell and second-surface mirror arrays were treated as though comprised of individual cells or elements with planar surfaces. The problem was to determine the angle between the plane of each cell or element and the substrate. This was accomplished by directing a collimated laser beam incident at a small angle on each cell or element, the beam size being slightly less than the cell size. A measure of the normal for each element was obtained by setting up a screen to intercept the reflected beam and observing the location of the center of this reflected beam relative to the incident beam. Note that the sample normal lies halfway between the incident and reflected beams as illustrated in the upper part of Fig. 11. The angle (position on the screen) of the sample substrate normal was determined by replacing the sample with a large plane mirror. In this way we found the angle of each element relative to the substrate. Precision, as determined by repeated measurements, was found to be within ±1 mrad.

The procedure followed for these measurements was as follows: (1) mount the sample on the x, y positioner, (2) place a plane mirror on the substrate and record where its reflection falls on the screen, (3) position the sample in x or y for reflection from one cell, and (4) record on the screen the position of the reflected beam by writing the cell number at what appears to be the center of the pattern. The beam pattern was distorted, of course, because the cell surface was not entirely planar. Figure 12 illustrates how the area condition numbers were assigned to the individual elements of the solar cell and second-surface mirror samples.

To check measurement precision, a different team of workers repeated the same measurements on two 36-element samples. The average angular displacement values thus obtained agreed to within 1 mrad with the original measurements.

A scatter diagram of the cell reflectance for one of the solar cell samples manufactured by Centralab (and thus referred to as a C-type solar cell) is shown in Fig. 11. This type solar cell has two reflections from each element as indicated by the X and 0 in the figure. The coordinate system was constructed using the plane mirror reflection as the origin, with the X axis horizontal and passing through the laser source beam (off to the left of the figure). The coordinates of each beam reflection were then recorded in inches and transcribed to punched computer cards. A computer program was used to: (1) convert the reflection displacements into direction normal displacements in centimeters, (2) calculate the zenith and azimuth angles of the cell's direction normal, and (3) place these data on computer cards. A listing of all measured data appears in Appendix A.

4.2. DIRECTIONAL REFLECTANCE AND EMITTANCE

Two instruments were utilized to determine the spectral character of the sample materials. One was a Beckman DK-II spectrophotometer to measure the spectral directional reflectance

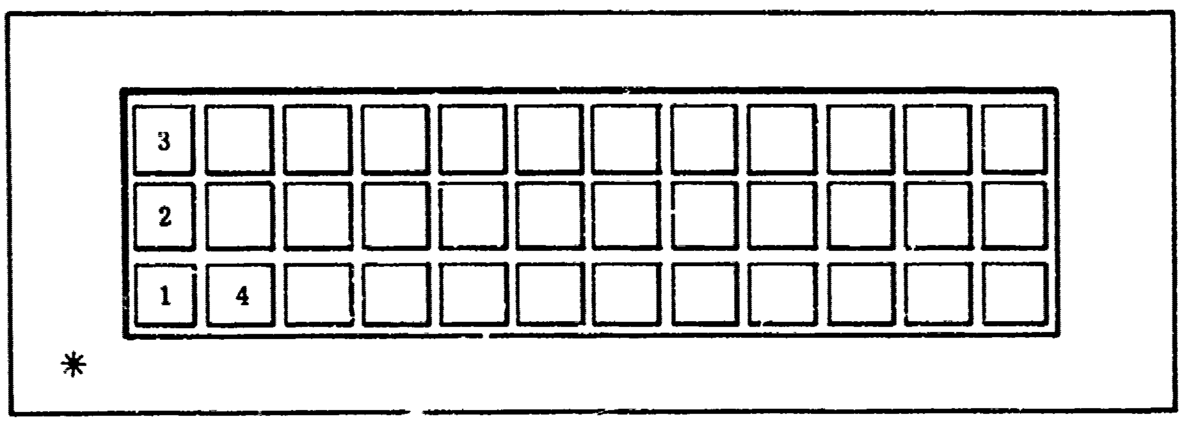


FIGURE 12. CELL NUMBERING FOR SOLAR CELLS AND MIRRORS. Shingles are always numbered from bottom to top, left to right. Asterisk shows beginning of cell numbering.

(ρ_d) over the spectrum extending from 0.24 to 2.6 , ʳ The second instrument, an emissometer, measured the spectral directional emissivity i.. '. 22 μm spectrum: it was constructed by ERIM personnel under sponsorship of ARPA, c · ⊃AHC 15-67-C-C062, and utilized here on a non-interference basis. Both instruments ar described in succeeding sections.

4.2.1. BECKMAN DK-II SPECTROPHOTOMETER

This general-purpose laboratory instrument was used for measuring ρ_d of the satellite surface materials. Because it is a ratio-recording instrument which employs the double-beam concept and utilizes common electronics, sources, and detectors, it can reduce systemic errors induced by changes in the system. Energy from a prism monochromator is chopped and alternately illuminates a reference and measurement sample mounted in an integrating sphere coated with barium suflate (see Fig. 13). Energies reflected from the sample and the reference are alternately detected and the ratio recorded on an x-y recorder.

Source incidence angle on the sample is either 0^o or 5^o, depending on the measurement quantity required. The angle is changed at the mounting part by reversing the sample plate. At 5^o incidence, the total hemispheric reflectance is measured: whereas at 0^o, the specular component is excluded and the measured value consists of only that part considered diffuse. All data were measured at 5^o to include the specular component.

All ρ_d measurements were made at approximately 70^oF using a $BaSO_4$ reference standard and a sample surface area of approximately 3/8 in. diameter. Necessary corrections for the reference sample reflectance were made: thus the data provided is absolute and not relative to barium sulfate. The instrument has a measurement precision of 1% and absolute accuracies better than ±5% can be expected. Spectral resolution with the integrating sphere reflectance attachment varies from 50 Å in the visible spectrum to several hundred Angstroms at 2.6 μm.

The graphical data were digitized and these values punched on computer cards. The cards were run through a computer program which corrected the data for the reference used, and generated another set of computer cards containing the absolute reflectance values in the appropriate ERAS format.* Computer plots of the absolute directional reflectance data were also made. The resulting data are presented in Appendix B of this report.

4.2.2. SPECTRAL EMISSOMETER

The spectral directional emissivity measurements (ϵ_d) were taken with an emissometer constructed by ERIM personnel. The emissometer is illustrated schematically in Fig. 14.

(1) The sample is mounted on a sample holder maintained at a constant temperature by a circulating liquid. Thermal contact is maintained by mechanically fastening the sample to the

*The Expanded Retrieval Analysis System (ERAS) developed by ERIM personnel is further described in Appendix F.

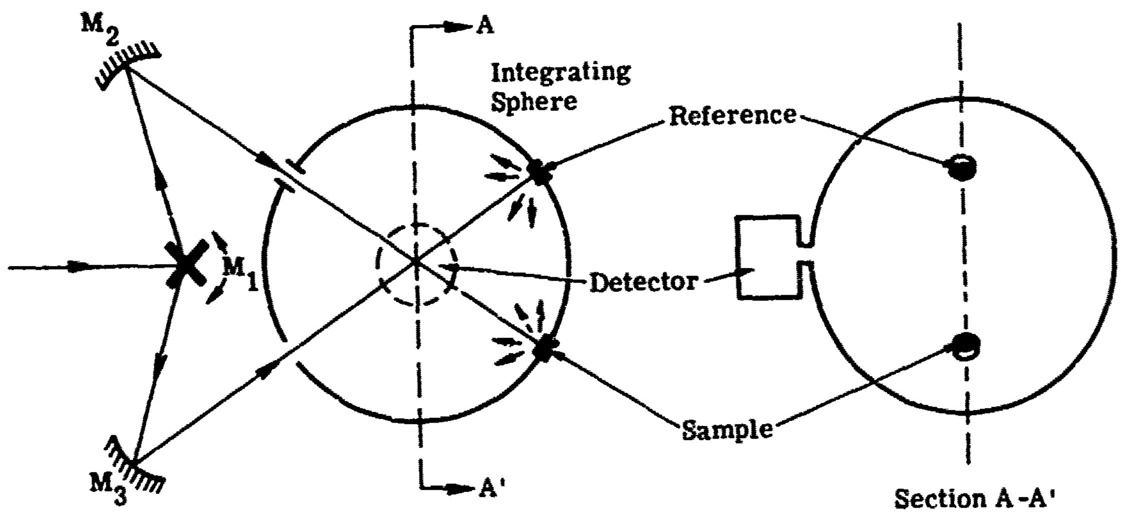


FIGURE 13. OPTICAL SCHEMATIC OF THE BECKMAN SPECTROPHOTOMETER WITH REFLECTANCE ATTACHMENT

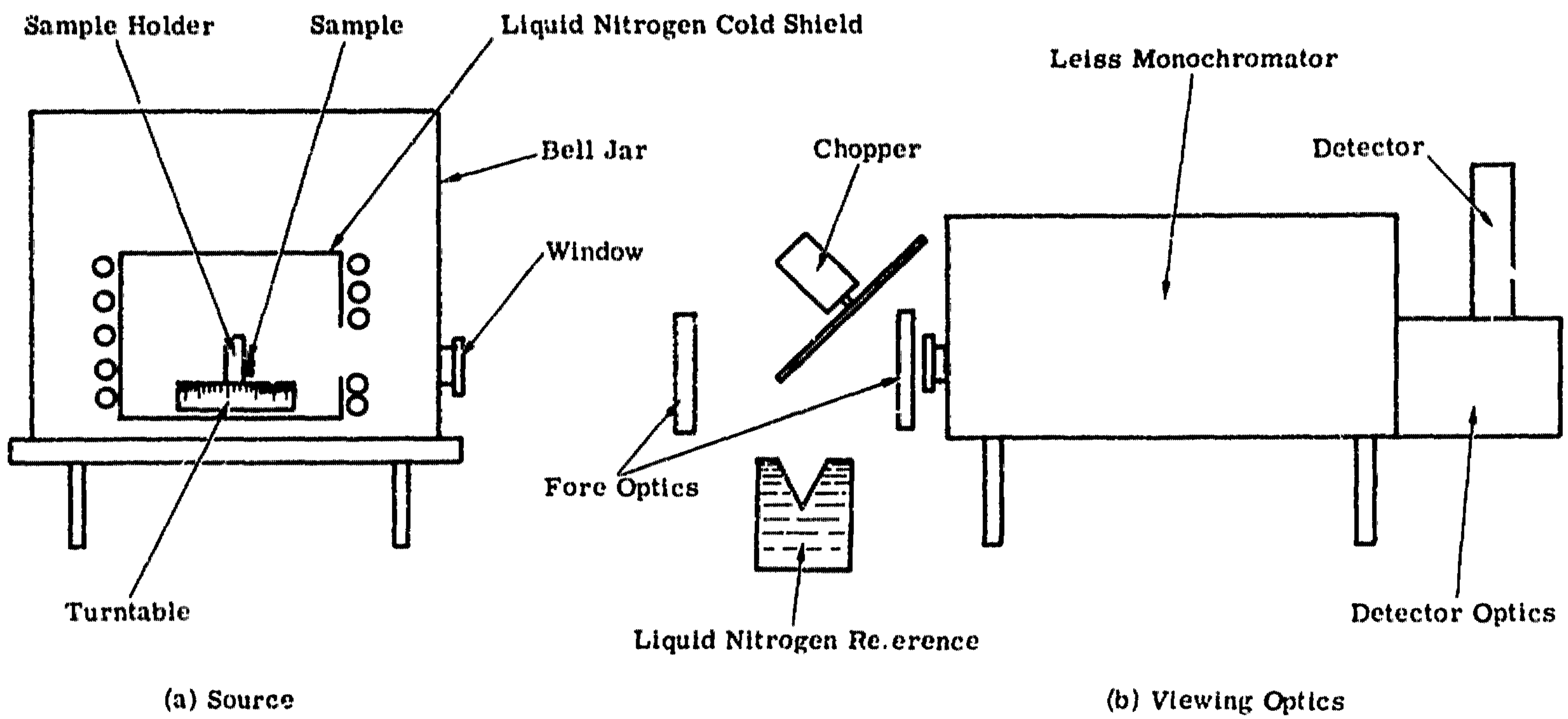


FIGURE 14. SPECTRAL DIRECTIONAL EMISSOMETER

heater. Measurements were made at sample temperatures of $296^{o}K$ and $373^{o}K$ using tap water and boiling water pumped through the heater to maintain a constant temperature.

(2) The heated sample holder has a blackbody reference on its reverse surface. The holder is mounted on a turntable to allow sample viewing angles of 0^{o} to 80^{o} and also blackbody viewing.

(3) A 3M black-coated cylindrical shield surrounds the holder to eliminate the possibility of stray radiation reflecting from the sample. This shield is held at $77^{o}K$ by means of liquid nitrogen, and the whole assembly is housed in an evacuated metal bell jar to eliminate frosting and cooling of the sample by currents of air.

(4) Emitted radiation is collected by the standard Leiss fore-optics and chopped. The chopper blades have gold mirror surfaces. When the sample irradiance is interrupted, the blades receive irradiance from another blackbody reference plate at $77^{o}K$.

(5) Source radiation is focussed by a Leiss double-prism monochronomator.

(6) The output energy is focussed by a reflector on a Ge:Cu detector whose output is fed to a lock-in amplifier and displayed on a chart recorder. Background radiance is determined by viewing the reference blackbody on the sample holder when it is cooled to liquid nitrogen temperature.

Data collection is initiated by first making a wavelength scan of the reference; this yields a blackbody curve at the sample temperature to use for calibration. Wavelength scans are made with the sample oriented at particular aspect angles. The gain setting is maintained at that used for the reference scan. After a series of scans has been run, a second scan is made of the blackbody to verify that the system is operating correctly. Subsequently, a scan of the blackbody cooled to liquid nitrogen temperature permits establishment of a zero reference level.

The analog chart data is then digitized and punched on computer cards. These cards are used as an input for a computer program that calculates the emissivity of the sample and outputs this information on computer cards in the ERAS format. Data taken with this instrument are presented in Appendix B.

As the measurement plan was developed, it was decided that published data could be used to supply the spectral reflectance and emissivity data needed to cover the 3- to 22-μm region. Table 3 shows the sample numbers and sources of data on those samples for which other data were utilized and reported herein.

4.3. BIDIRECTIONAL REFLECTANCE MEASUREMENTS

The gonioreflectometer system was used to acquire the diffuse and specular ρ' measurements. The facility is rather complex, and a number of changes were required so that the measurements could be performed. Its description is presented below in three parts: First, a general description of the system; second, a discussion of those features unique to the ρ' diffuse measurements; and third, a section treating those areas unique to the ρ' specular measurements.

TABLE 3. PUBLISHED DATA FROM OTHER LABORATORIES

Sample Number	Source of Data
3212	Honeywell [4]
3213	TRW Report [5]
3215	TRW [6]
3216	IITRI [7]

4. Heinisch, R. P.. Radiation Properties Measurements for Baffle Systems, S & R TM 3366-001, Honeywell Document 12312-FRI, Honeywell Corp., Minneapolis, December 1971.

5a. Leudke, E. E., Solar Absorptance Measurement Report on Eight Aerojet Mirror Samples, Report No. 8526.16-71-66, TRW Corp., Redondo Beach, California, 7 May 1971.

5b. Major Gilbert, SAMSO, Personal Communication to M. Bair, Willow Run Laboratories of the Institute of Science and Technology, The University of Michigan, Ann Arbor, May 1972. Emittance Measurements made by Dr. Stierwalt, Naval Electronics Laboratory Center.

6. Leudke, E. E., TRW Corp., Redondo Beach, Personal Communication to M. Bair, Environmental Research Institute of Michigan, Ann Arbor, 23 January 1973.

7. Gilligan, J. E., IITRI, Chicago, Personal Communication to M. Bair, Willow Run Laboratories of the Institite of Science and Technology, The University of Michigan, Ann Arbor, 20 December 1972.

4.3.1. GENERAL DESCRIPTION

All five axes of the goniometer are driven with dc motors and provide axis position information to $\pm 0.05^{\circ}$ via synchros and dial indicators. An electrical indication of angle position is provided by a synchro follower with a chopper disk circuit arrangement for markers every 5° and by a 14-bit shaft encoder for digital data recording. In the digital mode, data may be recorded at angular increments of 0.1, 0.2, 0.4, 0.8, 1, 2, 4, or 8°.

The laser sources used were a Spectra-Physics Model 125 HeNe laser at $\lambda = 0.6328$ μm, and a Control Data Corporation Model 400 YAG laser operated in the CW mode at $\lambda = 1.06$ μm. A 190-watt xenon lamp was also used as an incoherent broadband visible light source to simulate the sun. These sources are located on tables about 8 ft from the center of the positioner with their beams directed onto the sample. Figure 15 depicts the 0.63 μm laser source and its position relative to the 5-axis positioner.

The optics used in the 0.6328 μm laser source are sketched in part (a) of Fig. 16. The light coming from the laser is linearly polarized by the Brewster windows used on the ends of the plasma tube. A polarization rotator permits rotation of the source polarization. The coherent radiation is chopped and collected by a lens that focuses the radiation onto a pinhole used to improve the beam distribution. A second lens collects the radiation passed by the pinhole and recollimates the light. The external iris is used to vary the beam diameter of the exit radiation. The 4% reflecting beam splitter is used to sample a portion of the beam so that the power fluctuations in the laser may be monitored and recorded for data processing.

The 1.06 μm source optics are illustrated in part (b) of Fig. 16. The laser radiation is passed through a polarizing prism that is rotated to change the linear polarization plane of the energy. The polarized light strikes a reflecting chopper which directs the radiation to the monitor for recording any power fluctuations of the laser output beam. Energy passing through the chopper illuminates a telescopic system with which beam size may be expanded. The external iris reduces the size of the beam or trims stray radiation.

A sketch of the broadband visible light source appears in Fig. 17. The light from the xenon arc lamp is collected and focussed by the first lens onto a ground glass diffuser. Immediately following the diffuser is a pinhole aperture and short pass filters which tailor the spectrum of the xenon lamp to closely simulate the exoatmospheric spectrum of the sun. (The spectral match was previously illustrated in Fig. 8.) Radiation from the filters is chopped at 90 Hz and a small amount reflected onto the monitor detector. Since the beam splitter introduces a polarization bias to the source radiation passing through, a second beam splitter was added to compensate for the polarization bias introduced by the first. The unpolarized energy is collected by the final lens which is adjusted so that a beam divergence of $1/2^{\circ}$ is obtained.

The receiver optics are dependent on the wavelength and the type of ρ' measurements being made; the receivers will be covered in succeeding text.

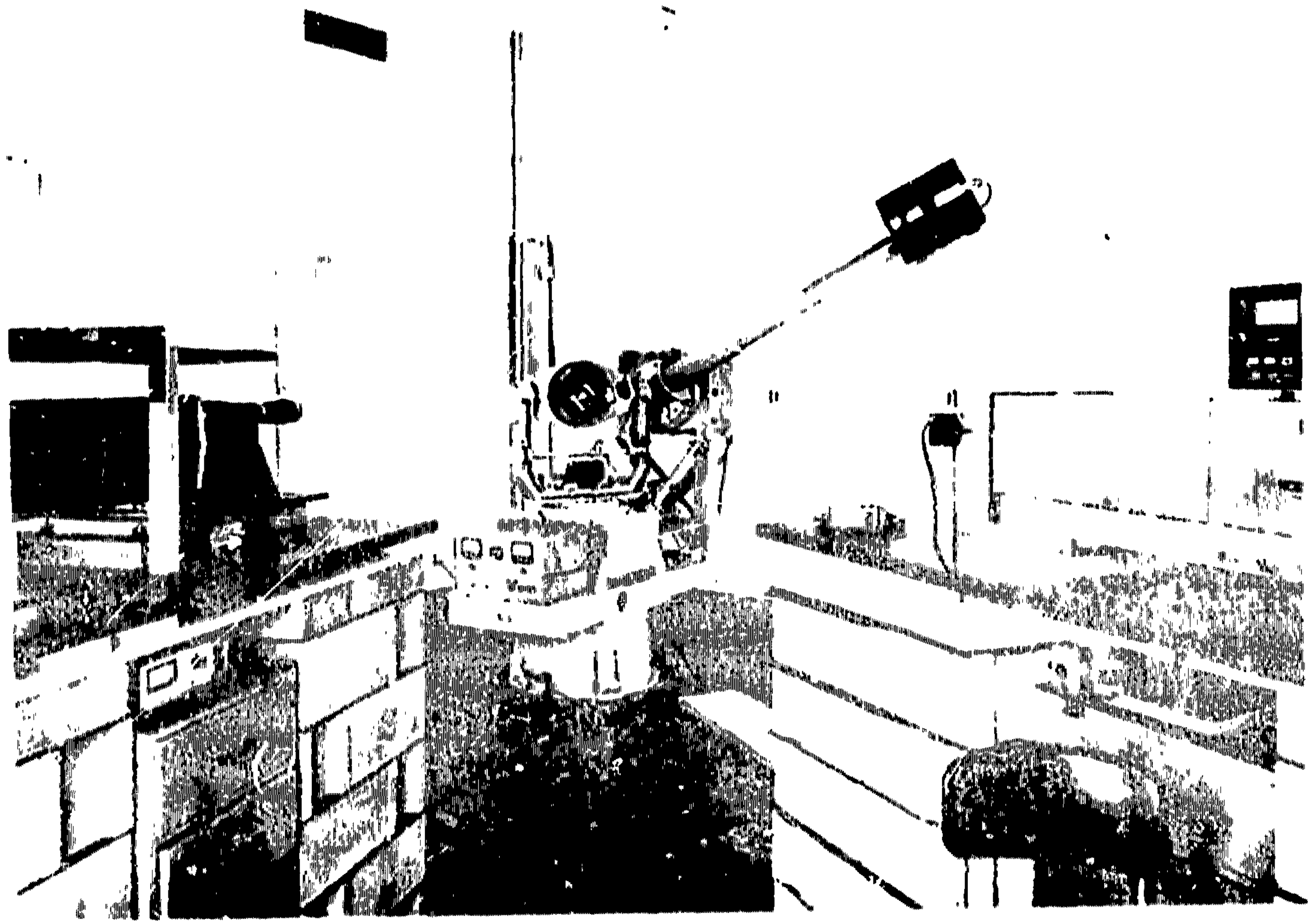
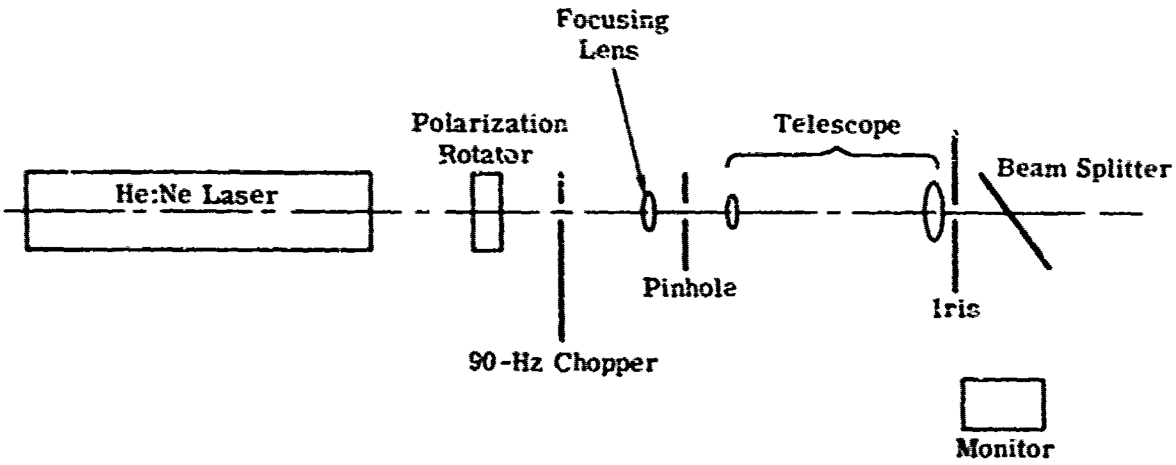
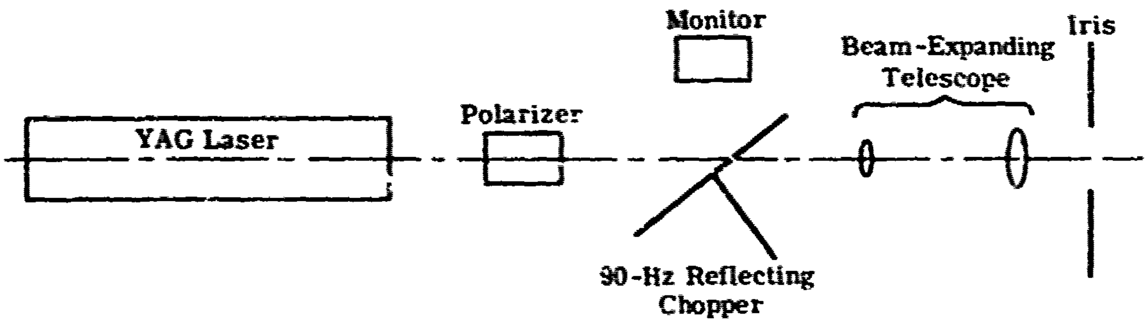


FIGURE 15. GONIOREFLECTOMETER FACILITY



(a) 0.6328 μm Goniometric Source



(b) 1.06 μm Goniometric Source

FIGURE 16. OPTICAL SCHEMATICS FOR TWO GONIOREFLECTOMETER SOURCES

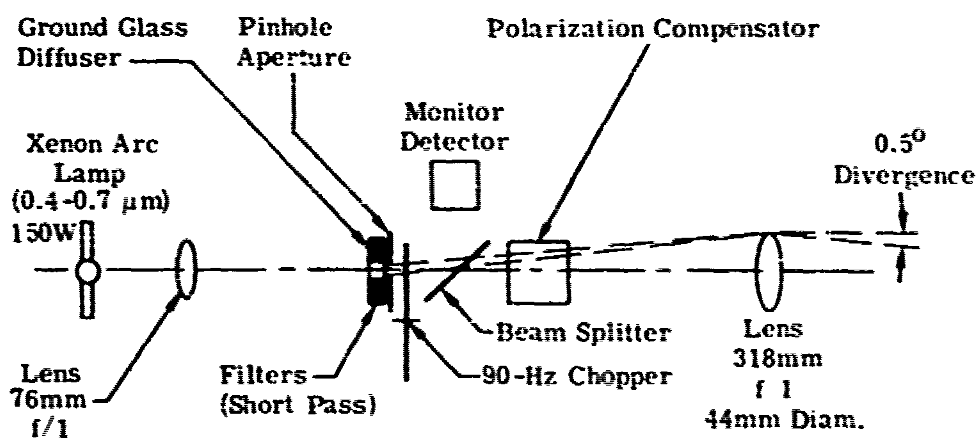


FIGURE 17. OPTICAL SCHEMATIC OF SOLAR SIMULATION SOURCE

Figure 18 diagrams the signal path for the gonioreflectometer. The signal from the receiver detector is first amplified by the preamp, transferred to the post-amplifiers via a set of low-noise slip rings in the positioner, and sent to a synchronous detector. The dc output from the synchronous detector is acquired by the multiplexer. A similar path is followed by the monitor signal. The signals from the receiver and monitor are alternately sampled, multiplexed, and serially applied to the A D converter for recording on an incremental tape recorder. The sample rate, limited to ~20 characters sec, is determined by the scan rate of the receiver and the setting of the angle increment switch (0.1°, 0.2°, 0.4°, etc.).

At the end of each day, the magnetic tape containing the day's runs is submitted to the ERIM computing facility. The data is then run through a series of computer programs (see Fig. 19) to obtain a printout of the ρ' values calculated. The first program simply gives one a listing of everything on the magnetic tape. This tape is run through the editing programs, and any errors detected in the print-out are corrected, after which another listing is made to be sure the corrections have been made. The corrected tape is then used as the input for the program that calculates the ρ' values. The output format for these ρ' values is called the TAPE3 format and is very useful in checking out the data. The data processing for all types of ρ' data on the gonioreflectometer is identical up to this point.

4.3.2. DIFFUSE ρ' MEASUREMENT HARDWARE

In our diffuse ρ' measurements we employed the receiver depicted in Fig. 20. The light reflected from the sample first passes through the neutral density filter (used where receiver saturation was expected) and through the polarization analyzer. Radiation from the analyzer illuminates the objective lens whose effective size is controlled by a variable iris used as an aperture stop. The collected radiation is imaged on a field lens which also is preceded by an iris which serves as a variable field stop for the receiver. The function of the field lens is to image the aperture stop on the diffuser located on the detector surface. The system presented is needed in order to reduce the errors introduced by detector contour sensitivity.

For diffuse measurements, the field stop is adjusted so that the receiver has about a 10° field of view, which is adequate for viewing a 1.5 in. source at 80° incidence. The aperture stop is nominally set for a 30 mm diameter which corresponds to a 3.0×10^{-4} sr solid angle. It should be noted that the polarization analyzer material, which was HN-22 for the broadband visible (0.4-0.7 μm) and the 0.63 μm laser, was changed to HR polaroid for the 1.06 μm laser measurements. Two thicknesses of HR polarizer were used to increase the extinction coefficient of the analyzer.

The spectral response of the broadbard visible system is shown in the three curves of Fig. 21. They represent: (1) the product of the spectral response of an S-20 PMT and the NASA exoatmospheric solar spectrum, (2) the spectral response product of the ERMA-I PMT and filtered xenon arc spectrum (taken from Fig. 8), and (3), the product of curve 2 and the trans-

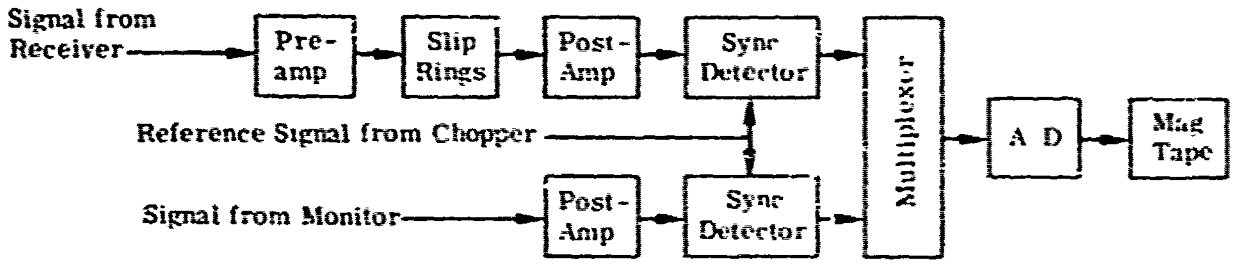


FIGURE 18. SIGNAL FLOW DIAGRAM

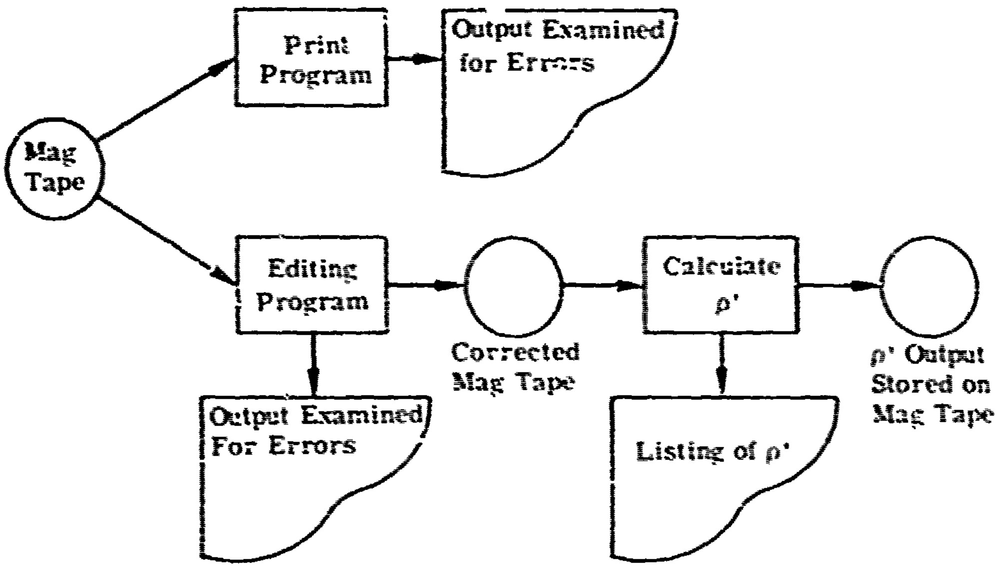


FIGURE 19. FLOW DIAGRAM FOR DATA PROCESSING

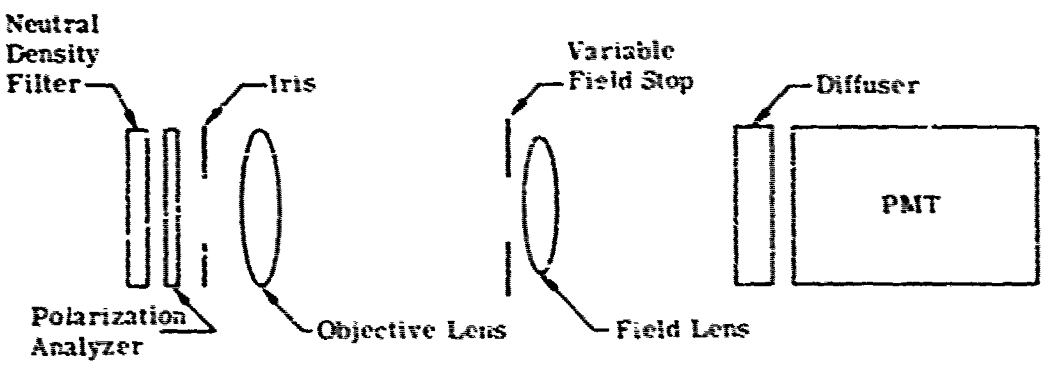


FIGURE 20. OPTICAL SCHEMATIC OF RECEIVER FOR DIFFUSE ρ' MEASUREMENTS

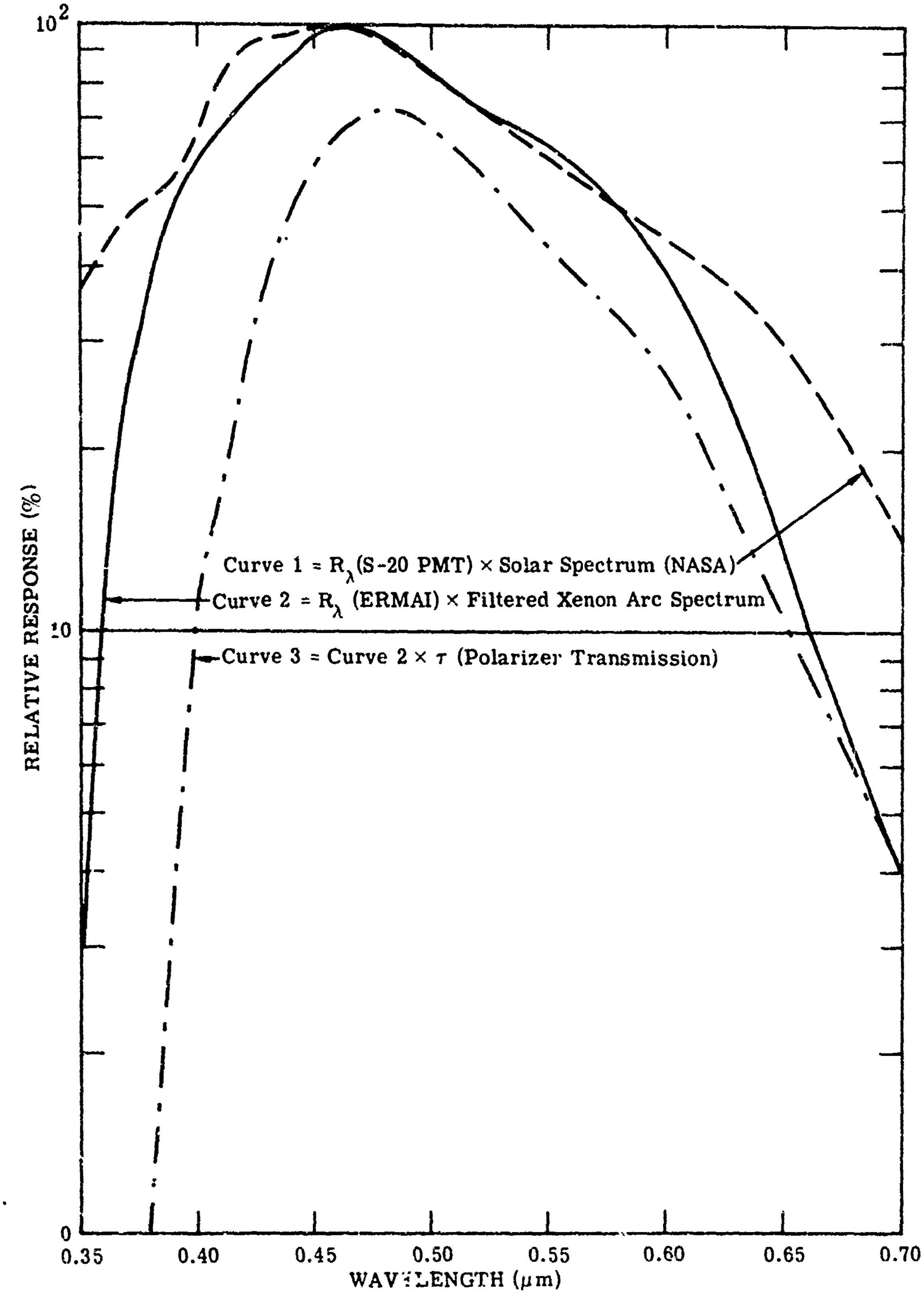


FIGURE 21. NORMALIZED SYSTEM SPECTRAL RESPONSE FOR VISIBLE SPECTRUM

mission of the HN-22 polarizing material. The third curve represents the relative spectral response of the broadband white light system. Curves (1) and (3) indicate the basic agreement achieved with the solar simulation. It is evident the polarizer significantly degraded the UV match.

Because of system configuration changes, two alternate methods of data calibration were used in this program. One method utilizes a reference sample with calibration obtained by comparative techniques. The second method is an absolute technique wherein the source is viewed directly to establish a calibration. In the first method, the calibration of the goniore-flectometer was accomplished by making ρ' measurements at 0^{o} incidence of a flame-sprayed aluminum (FSA) panel on which ρ_d measurements had been made by NBS. The voltages for the two or four polarization components were appropriately combined to find a calculated ρ_d value. This calculated ρ_d is then multiplied by a calibration constant so that it equals the ρ_d measured by NBS. The ρ' values are therefore referenced back to an absolute NBS measurement of ρ_d. All that is needed to calibrate the system is to mount the FSA sample, position the source and receiver in a known geometry, and record the signal. The signal recorded is proportional to the ρ' of the sample for that geometry and thus a calibration is obtained. The second method provides an absolute calibration. This is accomplished with the incident radiation being viewed by the receiver after appropriate signal attenuation with calibrated neutral density filters. The monitor is set up and recording started at the time the calibration is taken. Subsequent changes in source power are appropriately accounted for in final computation of the reflectance. Precision of the measurement instrument itself has been shown to be better than $\pm 2\%$, with calculated accuracies of the measurement system being better than $\pm 5\%$.

Correct sample alignment was necessary to obtain this precision. Sample alignment was accomplished by reflecting the incident beam back onto itself. For the diffusely reflecting samples, a plane mirror on the surface of the sample was used; when the sample was a specular reflector, the reflection from the samples own surface was used.

The output of the program for calculating ρ' values does not produce an output in ERAS format. Therefore the ρ' diffuse data had to be converted to the ERAS format. The proper commands are added to the ERAS output from the program mentioned above, and plots of the data are obtained. A compilation of the plots is presented in Appendix C.

A caution on interpretation of the diffuse ρ' data for the specular samples should be noted. Since ρ' is measured in sr^{-1}, the ρ' value measured at a specular reflection that subtends a solid angle smaller than the solid angle subtended by the receiver will be low. To illustrate, consider the case where the reflected beam is of 0.5 cm diameter and centered in a 2 cm receiver aperture. If one were to record the signal and then close the receiver aperture down to 0.5 cm, the signal measured would not change; however, the ρ' value calculated for the smaller aperture would be 16 times larger than for the larger aperture since the computations assume the aperture is fully illuminated. Because the specular reflections from the solar cells and

mirrors subtend a solid angle considerably smaller than the diffuse receiver's aperture, the values shown in Appendix C will be low at the specular positions. True values can be obtained at the specular position from Appendix D.

4.3.3. SPECULAR ρ' MEASUREMENT HARDWARE

A schematic of the receiver optics used for the ρ' specular measurements is shown in Fig. 22. The large objective lens creates the far field by placing the limiting aperture at the focal point of the lens. The size of this aperture controls the receiver's fields of view to either 0.2 or 0.4 degree. Neutral density filters (NDF) were used to prevent receiver saturation. The degree of linear polarization of the reflected radiation was determined by the rotating analyzer placed behind the NDF. A translucent diffuser positioned in front of the PMT eliminated the effects of the "hot" spots on photocathodes of the PMT.

Calibration procedures were basically the same as that employed with the ρ' diffuse measurements (Section 4.3.2). In calibration of the 0.4 to 0.7-μm data, a minor change was necessary because the receiver FOV was more restricted and did not view all the illuminated area. The incident beam was larger than an individual cell, therefore a mask was used to cover all but a single element on the sample. Similarly, a mask of the same size was used with the calibration reference panel. Since reflection of the 4% mask was significant, its reflection was determined and accounted for in the calibration procedure.

Before we began collecting matrix data, the samples were positioned so that their reflections were centered on the focal plane aperture when the receiver was in the center position of the matrix format. This positioning was checked at each of the angles to ensure proper alignment of the sample. To produce each 99-element matrix, nine gonioreflectometer scans are required.

After collecting the matrix data for each sample, the data are processed with the same software used in obtaining ρ' for the diffuse measurements. Further formating was then required to reduce the rectangular matrix to a 5- or 6-level bull's-eye representation (circular matrix).

Figure 23(a) shows the bull's-eye superimposed on a matrix constructed from data taken at 0.1° increments. Figure 23(b) shows how the bull's-eye fits over a matrix constructed from data taken at 0.2° increments. In both cases, the radii of the circles are the same, but in the case of the 0.2° increment data another ring is added to the bull's-eye giving a total of six values.

The construction of a circular matrix from the measured data is easily carried out, given the assumption that circular symmetry exists. The steps are:

(1) Each square of the rectangular matrix is assigned a number and a measured ρ' value.

(2) Each square is assigned a unit area.

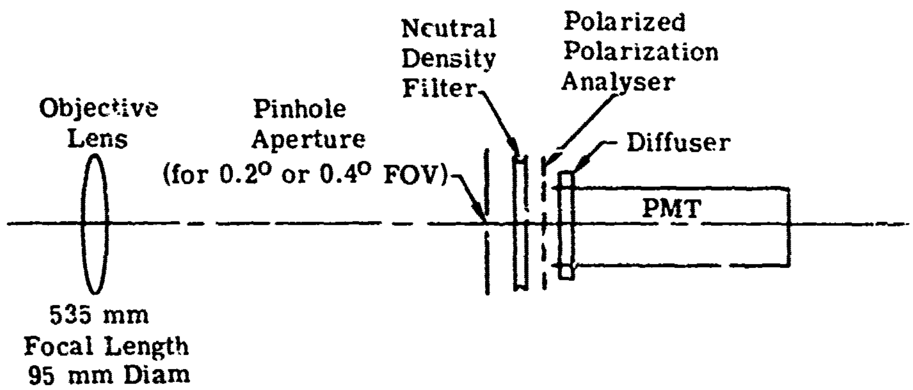
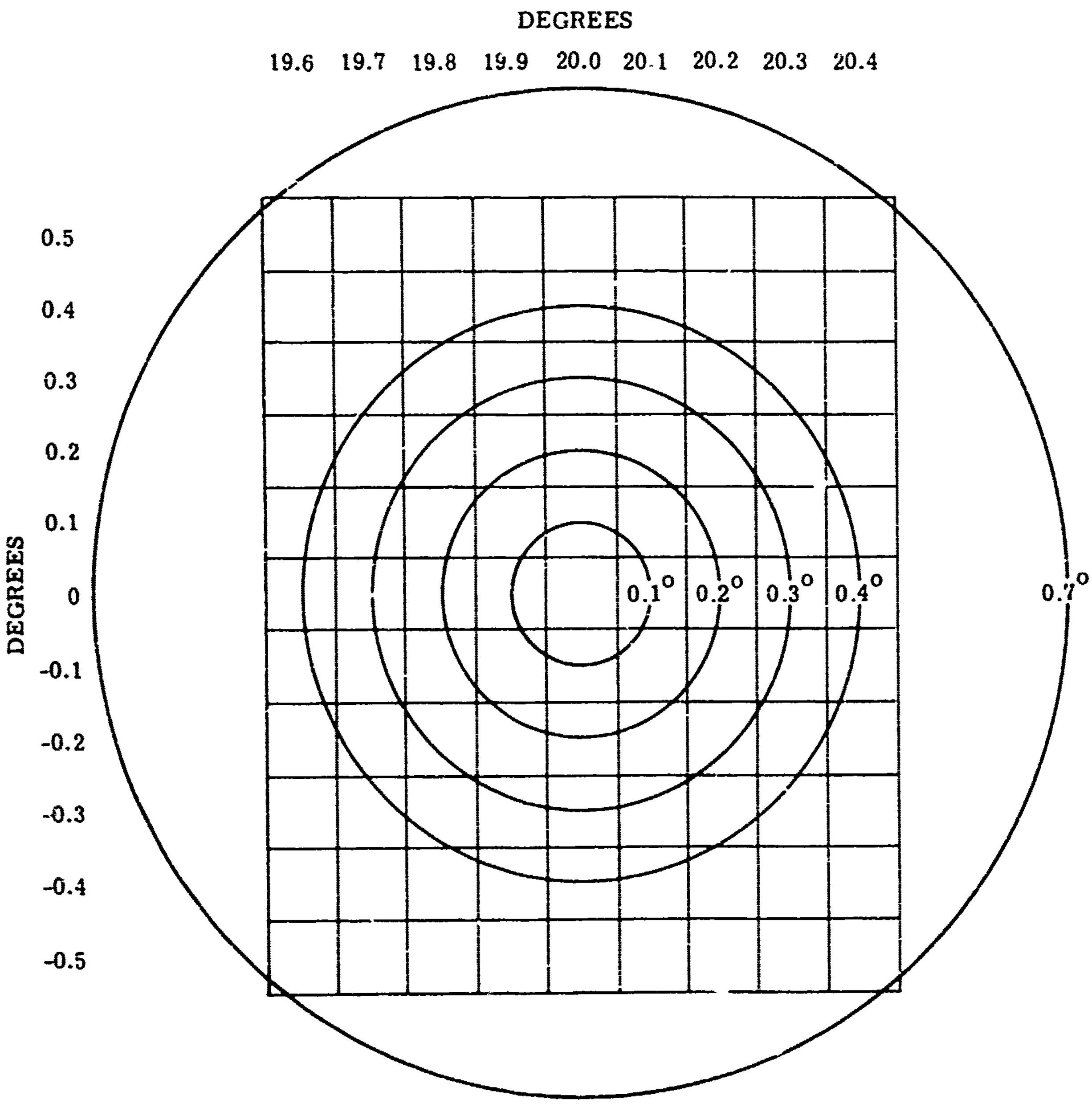
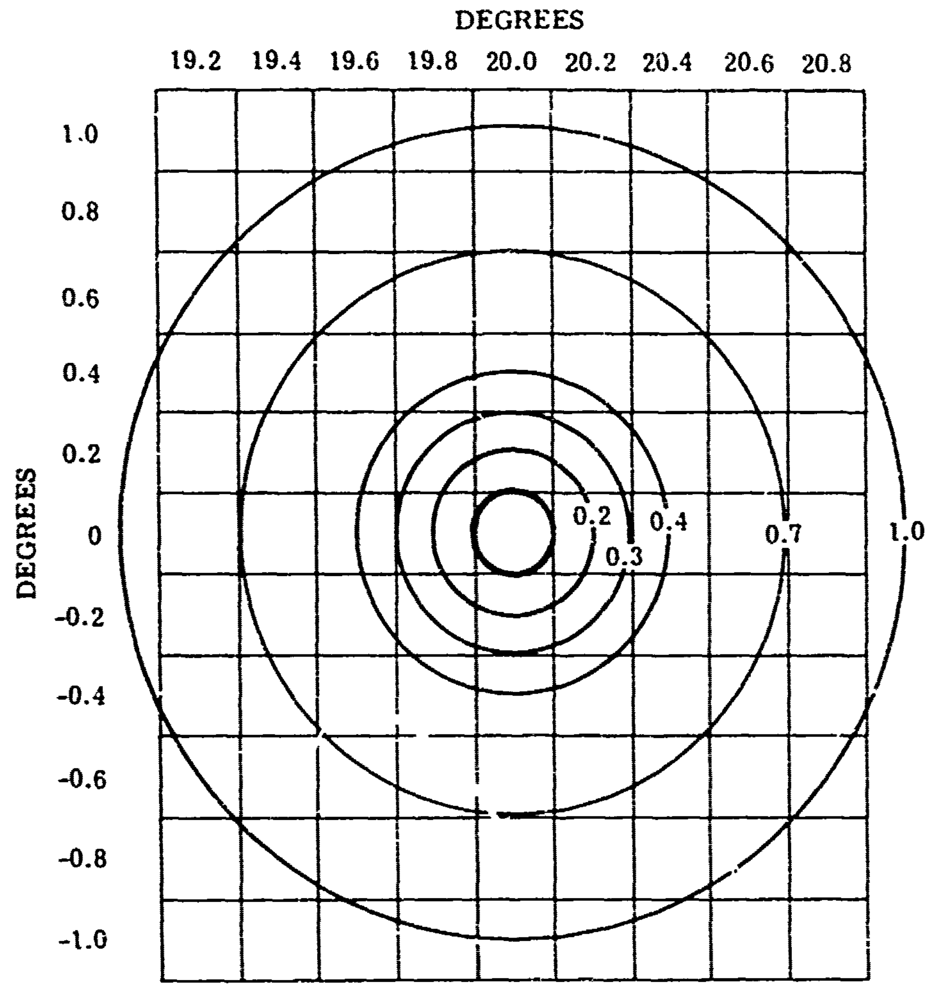


FIGURE 22. OPTICAL SCHEMATIC FOR SPECULAR ρ' RECEIVER MEASUREMENTS. Analyzer materials are HN-22 for 0.4 to 0.7 μm and 0.63 μm and HR for 1.06 μm. PMT is C7151Z (ERMAI) for 0.4 to 0.7 μm and 0.6328 μm; 7102 (S1) for 1.06 μm.



(a) For Data Taken at 0.1° Increments

FIGURE 23. MEASURED MATRIX AND BULL'S-EYE FORMAT



(b) For Data Taken at 0.2° Increments

FIGURE 23. MEASURED MATRIX AND BULL'S-EYE FORMAT (Concluded)

(3) Fractional areas are determined and assigned to a ring.

(4) Fractional ρ' values are computed for fractional areas determined in Step (3).

(5) Sum of ρ' values in a ring is divided by the sum of the areas.

Figure 24(a) shows a measured matrix containing the ρ' values. The equivalent bull's-eye is given in 24(b).

4.4. MEASUREMENTS AT 10.6 μm

The instrumentation assembly which was used in making the reflectance measurements at 10.6 μm is illustrated in Fig. 25. A functional diagram of the measurement system is depicted in Fig. 26. As shown, the 10.6-μm laser source and receiver system were positioned at ranges of 35 ft and 32 ft, respectively, from the sample. In an attempt to obtain an essentially collinear system, we minimized the angle subtended by the source and receiver (the bistatic angle, β) to 0.26°. This minimum angle was dictated by the physical sizes of the source and receiver hardware.

The linearily polarized source was a model 40 CRL laser with a measured beam divergence of 2 mrad. At a range of 35 ft, an area of approximately 0.8 in. diameter was illuminated in the sample plane,permitting the 2 cm solar cell elements to be fully radiated. The source radiation level was monitored through a reflecting chopper located at the source output. The polarization plane of the radiation could change as needed by the rotator.

The receiver had a field of view of 1.95 mrad which was determined by an IRTRAN II collecting lens, diameter = 0.87 in. All energy collected by this lens was imaged on the detector by a field lens. Background radiation effects were reduced by use of synchronous detection of the 90 Hz radiation at the detector output. The signal output was continuously recorded on a strip chart as the sample was rotated about a vertical axis. Angular position was recorded on the same chart by an event marker actuated by a cam-operated microswitch on the rotating table. During data collection the sample was rotated at $1/8^{\circ}$ sec about a vertical axis, allowing the sample normal to sweep through the horizontal plane containing the source and receiver.

Calibration of the reflectance data was accomplished by inserting a known standard reflector, flame-sprayed aluminum (FSA), in the laser beam about 8 ft from the receiver. This calibration signal, modified by a range factor, was utilized to establish the monitor reference. Changes in source power, as measurements proceeded, were recorded and used in data reduction as a correction factor.

The traces on the charts were digitized by hand and the values put onto computer cards along with calibration values, amplifier gains and, when necessary, values of optical attenuators used to prevent receiver saturation. The data were then run through a computer program which calculated the ρ' value for each digitized angle and arranged the data into the ERAS format. A listing, in ERAS format, of all the data taken at 10.6 μm is presented in Appendix E.

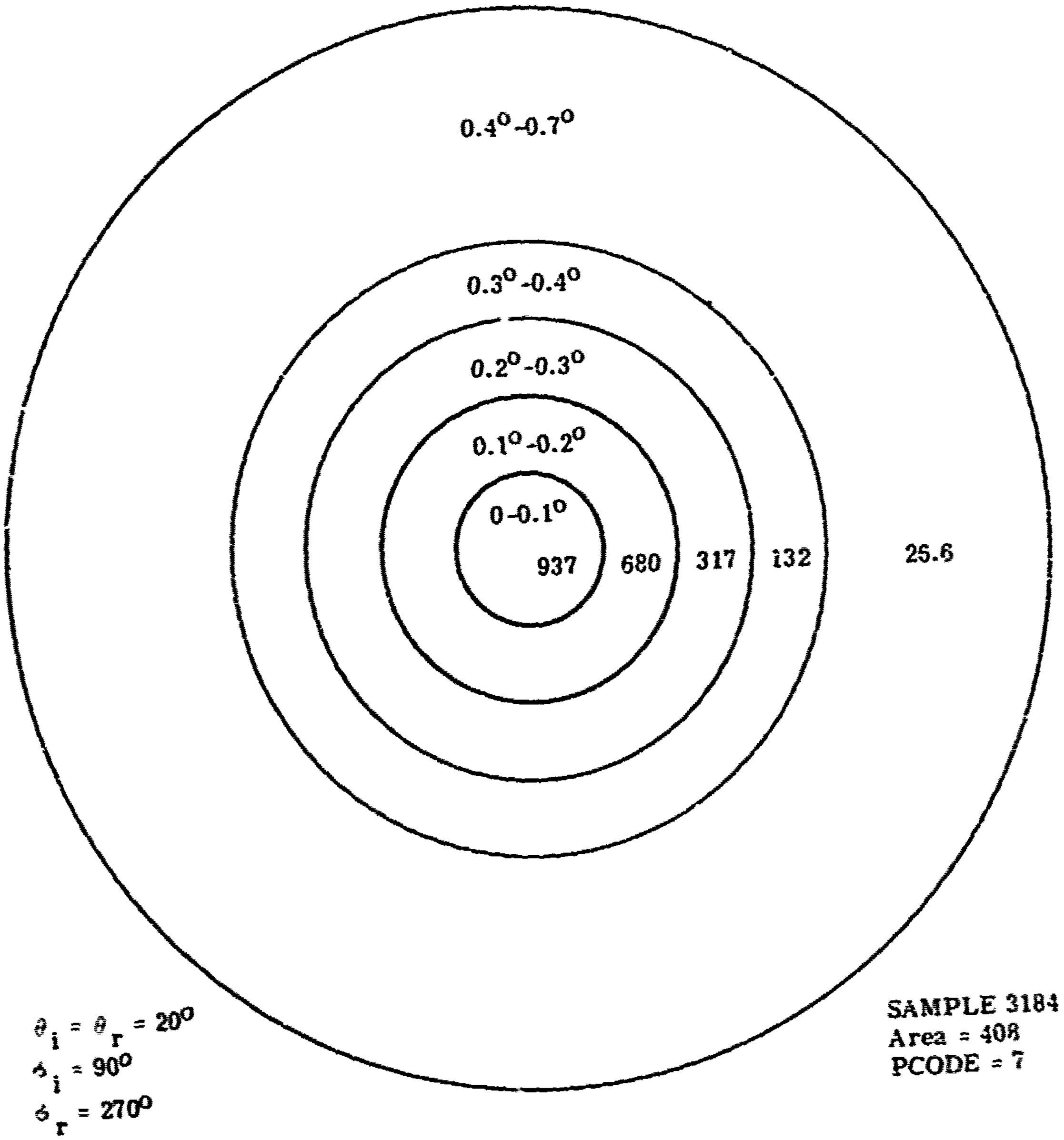
DEGREES

DEGREES	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4
0.5	5.9	4.2	4.7	6.8	0	0	0	2.8	2.1
0.4	8.0	5.4	5.9	22	24	14	0	3.8	2.5
0.3	10	12	14	178	229	151	64	28	5
0.2	10	30	35	388	464	328	161	83	8.3
0.1	14	89	108	833	882	647	353	191	15
0	17	139	172	1022	1035	748	421	217	17
-0.1	18	194	225	1009	982	688	358	155	16
-0.2	15	181	207	826	796	544	269	104	12
-0.3	8.2	100	112	431	421	285	129	44	7.2
-0.4	5.4	57	57	245	229	156	66	22	5.4
-0.5	2.4	17	15	70	60	43	17	6	2.4

Area = 408
PCODE = 7
$\theta_i = \theta_r = 20^\circ$
$\phi_i = 90^\circ$
$\phi_r = 270^\circ$
$\lambda = 0.4\text{-}0.7\ \mu m$

(a) Matrix Representation of a Solar Cell Specular Lobe

FIGURE 24. ρ' MATRIX DATA AND BULL'S-EYE REPRESENTATION (SAMPLE 3184). Area 408, PCODE 7.



(b) Bull's-Eye Representation of the Matrix Data

FIGURE 24. ρ' MATRIX DATA AND BULL'S-EYE REPRESENTATION (SAMPLE 3184). Area 408, PCODE 7. (Concluded)

FIGURE 25. THE 10.6 μm REFLECTANCE MEASUREMENT SYSTEM

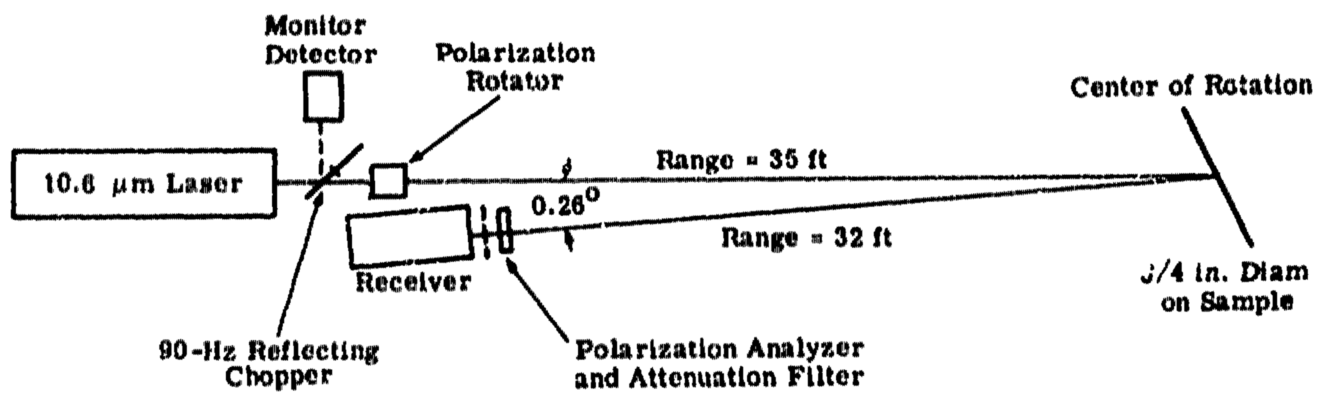


FIGURE 26. OPTICAL DIAGRAM OF 10.6 μm FIXED BISTATIC MEASUREMENTS

5
INTERPRETATION OF DATA

5.1. CHARACTERIZATION OF SPECULAR REFLECTANCE LOBES

5.1.1. BULL'S-EYE REPRESENTATION

Part way through the measurement program, the bull's-eye method of representing the amplitude and size of the specular reflectance lobe became a requirement for the AVCO reflectance model. It was known that all specular lobes were smaller than 2° so a standard set of intervals within a 2° cone was selected and each lobe represented by five or six ρ' values. This bull's-eye provided an intensity distribution within the lobe and allowed for a standardized angular format. Bull's-eye data on a solar cell (sample 3164-408) are plotted in Fig. 27 for the 0.4-0.7 μm spectral band. The same figure also gives values of ρ'_{max} and $\Delta\theta$ discussed in the next section.

The method for generating the bull's-eye values from the 99-element matrix is discussed in Section 4.3.3. This method imposes circular symmetry and assumes that the peak of the reflectance lobe is centered in the 99-element matrix to within $\pm 0.1^{\circ}$. If the peak is not centered, the 0° to 0.1° value of the bull's-eye will be reduced and outlying values increased. Thus, a small angular misalignment during the matrix measurement may result in an increase in the indicated width of the lobe.

5.1.2. PEAK VALUE AND EQUIVALENT CONICAL WIDTH

Before the bull's-eye representation of the specular lobe was devised, a computer program was written to find the peak value of the matrix and then compute an effective conical beam so that the product of the peak value and the solid angle of the conical beam accounted for all power within the matrix. Specifically, the relation

$$\rho'_{max}\frac{\pi}{4}(\Delta\theta)^2 = (\Sigma\rho'_{mn})(\Delta S)^2 \tag{14}$$

is solved for $\Delta\theta$, where

ρ'_{max} = the maximum value in the matrix
$\Delta\theta$ = the effective conical beam angle
$\Sigma\rho'_{mn}$ = the sum of the matrix values
ΔS = the angle spacing of the matrix

These ρ'_{max} and $\Delta\theta$ values were calculated for all matrices in addition to the bull's-eye values. The similarity of the two representations for the specular lobe is illustrated in Fig. 27, where the axes are marked at ρ'_{max} and at $\Delta\theta/2$.

Both ρ'_{max} and $\Delta\theta$ proved to be quite useful in summarizing and evaluating the matrix measurements; examples appear in the following subsections.

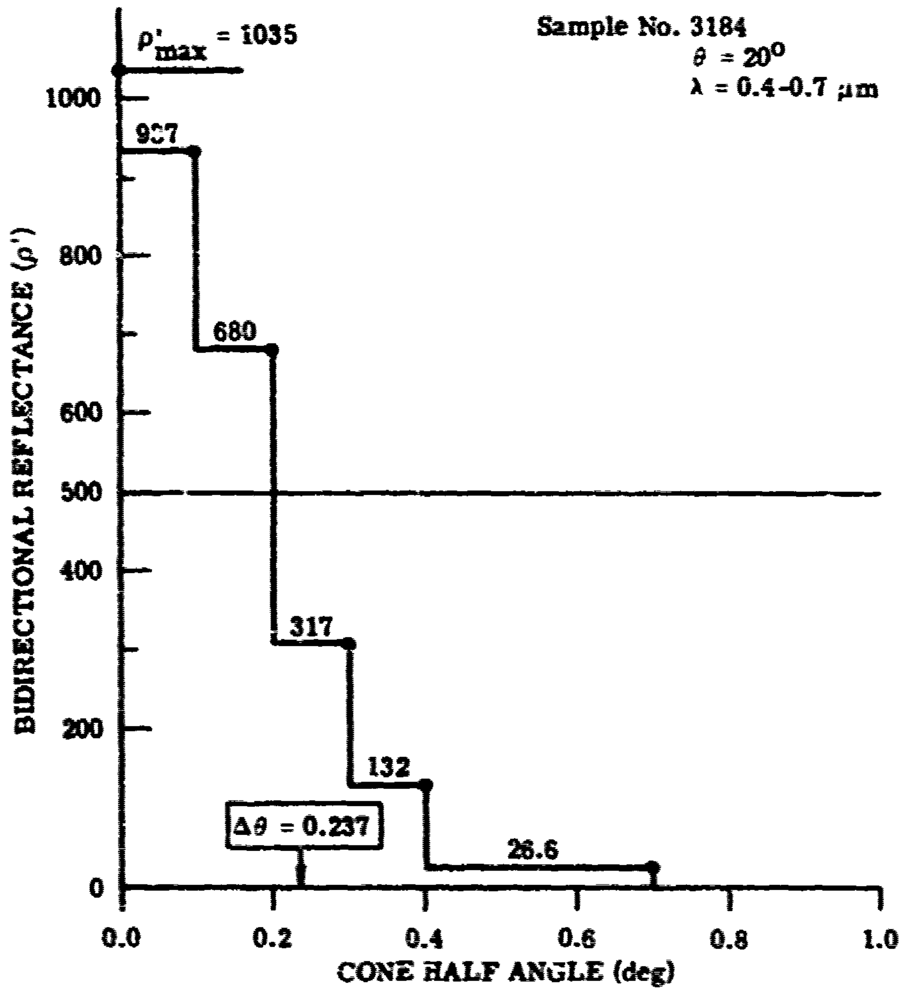


FIGURE 27. BULL'S-EYE REPRESENTATION OF SPECULAR LOBE

5.2. INFERENCES FROM DIRECTION NORMAL DATA AND SPECULAR LOBE WIDTHS

Data on the direction normals for each element of the solar cell and second-surface mirror arrays were initially reduced by computer to yield the average zenith angle, $\bar{\theta}_n$, and its standard deviation, θ_n rms, where the full cone angle spread is $2 \times \theta_n$ rms. The $\bar{\theta}_n$ and θ_n rms values for each sample have been used to gain insight into the relationship between the size of an average specular lobe and the spacing of lobes caused by the various sample elements.

Table 4 contains measured values of $\bar{\theta}_n$ and θ_n rms along with average specular lobe width, $\overline{\Delta\theta}$, and its standard deviation, $\Delta\theta_{rms}$, for the specular samples measured. The $\overline{\Delta\theta}$ values were obtained for an incidence angle of 5^0 using the solar simulation source. The average lobe width for six measurements was taken for each entry—i.e., three different elements on the sample viewed on two orthogonal azimuth planes. The large value for $\bar{\theta}_n$ (20–40 mr) is caused by shingling of the solar cell elements and indicates the departure of the average normal from the substrate normal. (Solar cell panels were assembled with the edge of one cell overlapping the next to produce a shingled array.) A comparison of 2 θ_n rms and $\overline{\Delta\theta}$ for the solar cells shows that the spread of the normals is about twice the "size" of the specular lobes. Therefore, the controlling factor on beam size for reflection from an entire array will be the mechanical lay-up of the cells rather than the character of the individual cell lobe.

Referring again to Table 4, $\bar{\theta}_n$ for all three second-surface mirrors is small (less than 1.6 mr) because the samples are essentially flat. Twice the rms deviation of the mirror normals range from 3.4 to 10.4 mr, whereas average lobe size ranges from 7.7 to 20.3 mr. Thus, for second-surface mirrors, the character of individual elements tends to dominate over or be equivalent to the effect of the lay-up of the elements. The reason for such a large cone angle as $\overline{\Delta\theta} = 20.3$ mr for sample 3194 is probably related to flexing of its fiberglass substrate. The substrates for the other two second-surface mirrors were metal and the cone angles were smaller and and similar, 7.7 and 8.2 mr.

5.3. ANGULAR AND WAVELENGTH PROPERTIES

Examination of the ρ' specular matrix data using the ρ'_{max}, $\Delta\theta$ representation can be helpful in obtaining an insight into the way the data behaves. Figures 28 and 29 are plots of ρ'_{max} versus θ_i for a solar cell, sample number 3182 (sample 3182 is an H-type solar cell). All of the data in Fig. 28 is for an azimuth $\phi_i = 0^0$, while its individual curves have wavelength and polarization as parameters. Figure 29, for $\phi_i = 90^0$, presents data in every other way comparable to that of Fig. 28.

Focussing attention on the two curves in Fig. 28 for the wavelength of 0.63 μm, it is obvious that the receiver polarization components parallel to the incident plane (PCODEs 2 and 6)* decrease with θ_i while the receiver perpendicular components (PCODEs 5 and 7) increase

*Consult Appendix C for PCODE definitions.

TABLE 4. COMPARISON OF LOBE WIDTHS AND DIRECTION NORMALS

Sample Name	Number	Matrix Measurements, $\theta = 5^{\circ}$, $\lambda = 0.4-0.7\ \mu m$		Direction Normal Measurements	
		$\Delta\theta$(mrad)	$\Delta\theta_{rms}$ (mrad)	$\bar{\theta}_n$ (mrad)	θ_n rms (mrad)
C-Type Solar Cell	3181	10.6	1.11	24.8	12.6
C-Type Solar Cell*	3181'	13.4	3.8	23.2	13.2
C-Type Solar Cell	3184	10.0	1.47	30.1	14.2
C-Type Solar Cell*	3184'	10.0	1.91	27.6	13.2
C-Type Solar Cell	3185	10.0	1.91	41.3	13.1
C-Type Solar Cell*	3185'	11.3	1.09	38.9	13.8
H-Type Solar Cell	3179	14.9	1.80	19.3	12.8
H-Type Solar Cell	3182	21.4	1.31	19.3	12.9
H-Type Solar Cell	3183	12.6	2.53	20.7	11.2
2nd Surface Mirror (Fiberglass Substrate)	3194	20.3	3.3	0.6	2.9
2nd Surface Mirror (Aerojet-Alum. Substrate)	3190	7.7	0.91	1.6	5.2
2nd Surface Mirror (TRW-Alum. Substrate)	3165	8.2	0.75	0.9	1.7

*Second reflection of C-type cells.

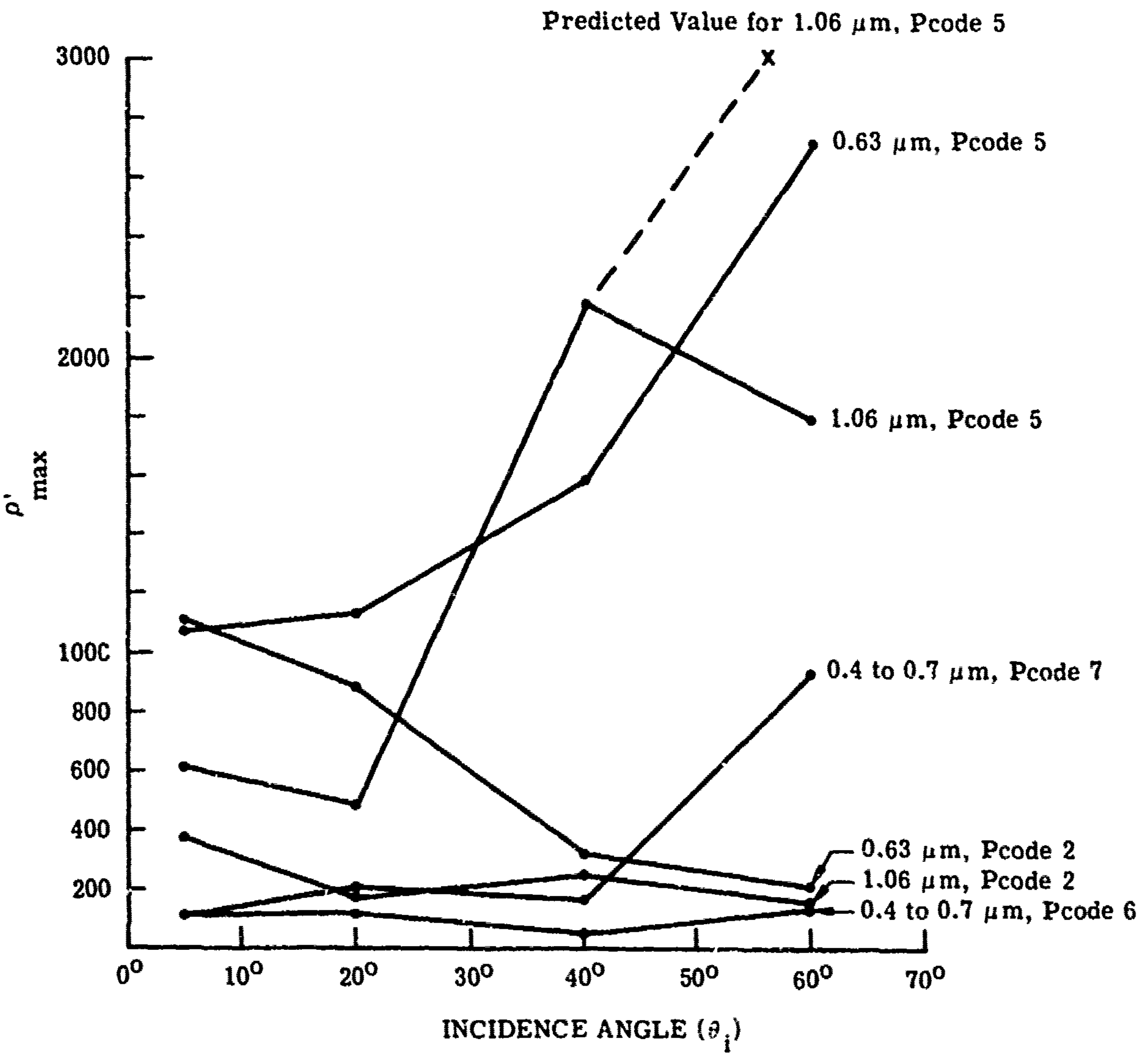


FIGURE 28. WAVELENGTH AND ANGULAR DEPENDENCE OF SOLAR CELL REFLECTANCE (SAMPLE 3182), $\phi_i = 0^{\circ}$

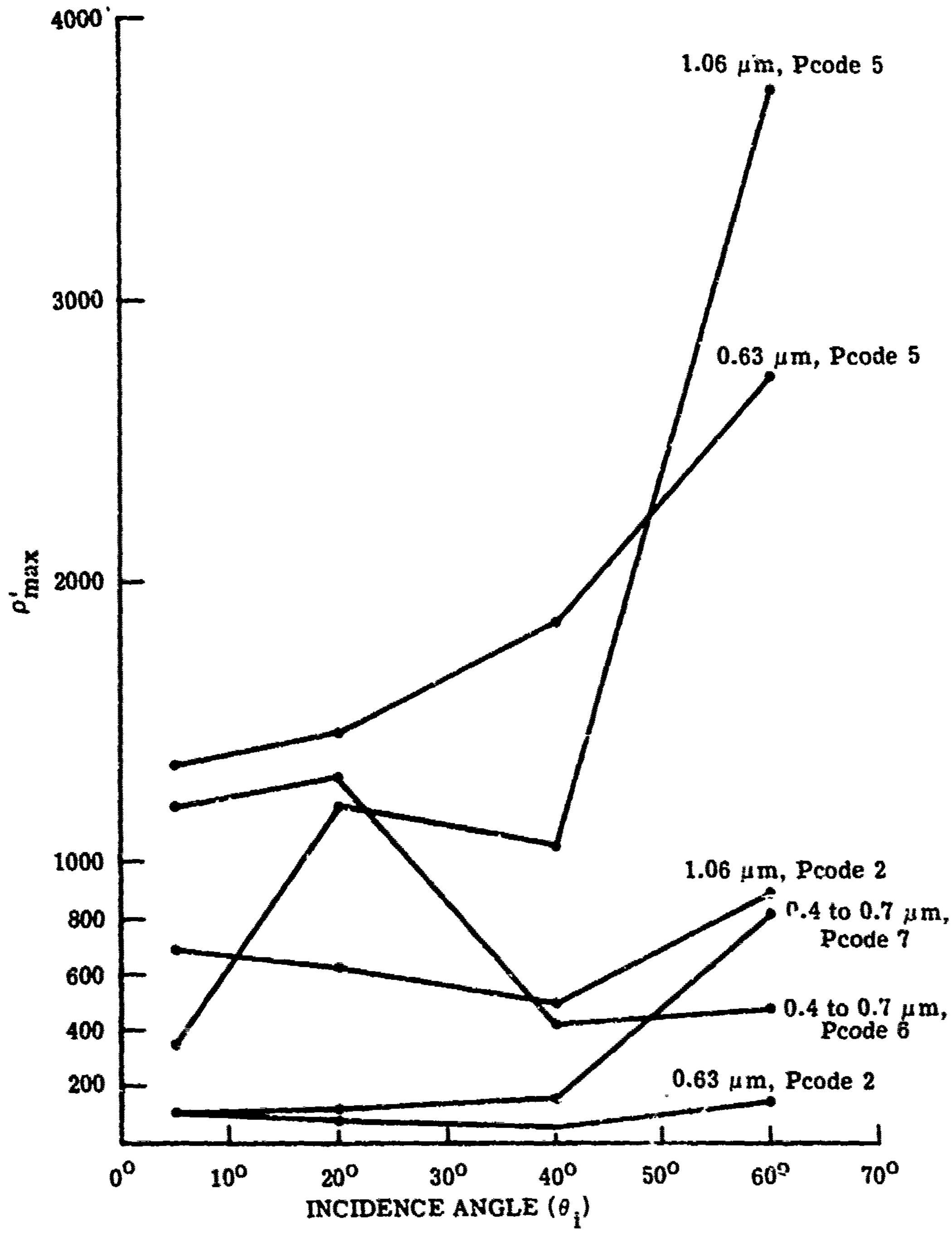


FIGURE 29. WAVELENGTH AND ANGULAR DEPENDENCE OF SOLAR CELL REFLECTANCE (SAMPLE 3182), $\phi_i = 90^\circ$

sharply with increasing θ_i. This behavior is characteristic of a Fresnel reflection and is as would be expected. Further examination of Figs. 28 and 29 shows that this characteristic is independent of the azimuth plane or wavelength. One might take exception to the above statement, citing the 1.06 μm, PCODE 5 curve in Fig. 28. After examination of other data for similar cells, it is evident that the point at $\theta_i = 60^o$ is questionable. Data on other cells would indicate that the point labeled A on Fig. 28 would be the expected point. If the "expected" point were used, all of the data behaves as stated.

Comparison of Figs. 28 and 29 may indicate some dependence on the ϕ plane; however, further examination of these as well as additional data indicates that the variance with phi plane does not follow any easily discernible pattern, and that the cell-to-cell variance is larger than the azimuthal variance shown here. The broadband visible measurements show the least azimuthal variance; this lack of variance may be attributable to the increased divergence of the broadband visible source.

The effective cone angle ($\Delta\theta$) is plotted versus incidence angle with wavelength, polarization, and phi plane as parameters (see Figs. 30 and 31). The most striking feature seen in these two figures is the way in which the 0.63 μm and 1.06 μm data are of the same magnitude while the broadband measurements display angles 3 to 4 times larger. This was expected. Recall that the 0.63 μm sources are collimatedwhile the broadband source was designed to have a 1/2 degree divergence. This source divergence increases reflected divergence and thus increases $\Delta\theta$. It is also apparent from Figs. 30 and 31 that there is little change in $\Delta\theta$ for the two azimuth planes and, as was the case with ρ'_{max}, any changes in $\Delta\theta$ between azimuth planes is of the same or smaller magnitude than the variance observed between cells.

5.4. CALCULATION OF EQUIVALENT REFLECTANCE

The spectral directional reflectance was measured for the samples as shown in Appendix B. It is also possible to calculate a directional reflectance for a sample at a specified wavelength or wavelength band by integrating the ρ' measurements over the hemisphere. In most cases a simplified integration over the solid angle of the specular reflectance lobe will yield a good approximation to ρ_d—hence the expression "equivalent directional reflectance" (Eq ρ_d); it is defined as

$$\text{Eq}\,\rho_d = \rho'_{max}(\Delta\theta)^2 \frac{\pi}{4} \cos\theta_i \tag{15}$$

where the cos θ_i term compensates for a projected solid angle term used in the computation of ρ'. Of course this neglects the diffusely reflected components, which are known to be small.

An Eq ρ_d value was determined for all specular samples measured and was used as a type of quality control factor to ensure that the matrix values generated were reasonable. The Eq ρ_d data have been averaged and plotted as a function of incidence angle for all measured data in

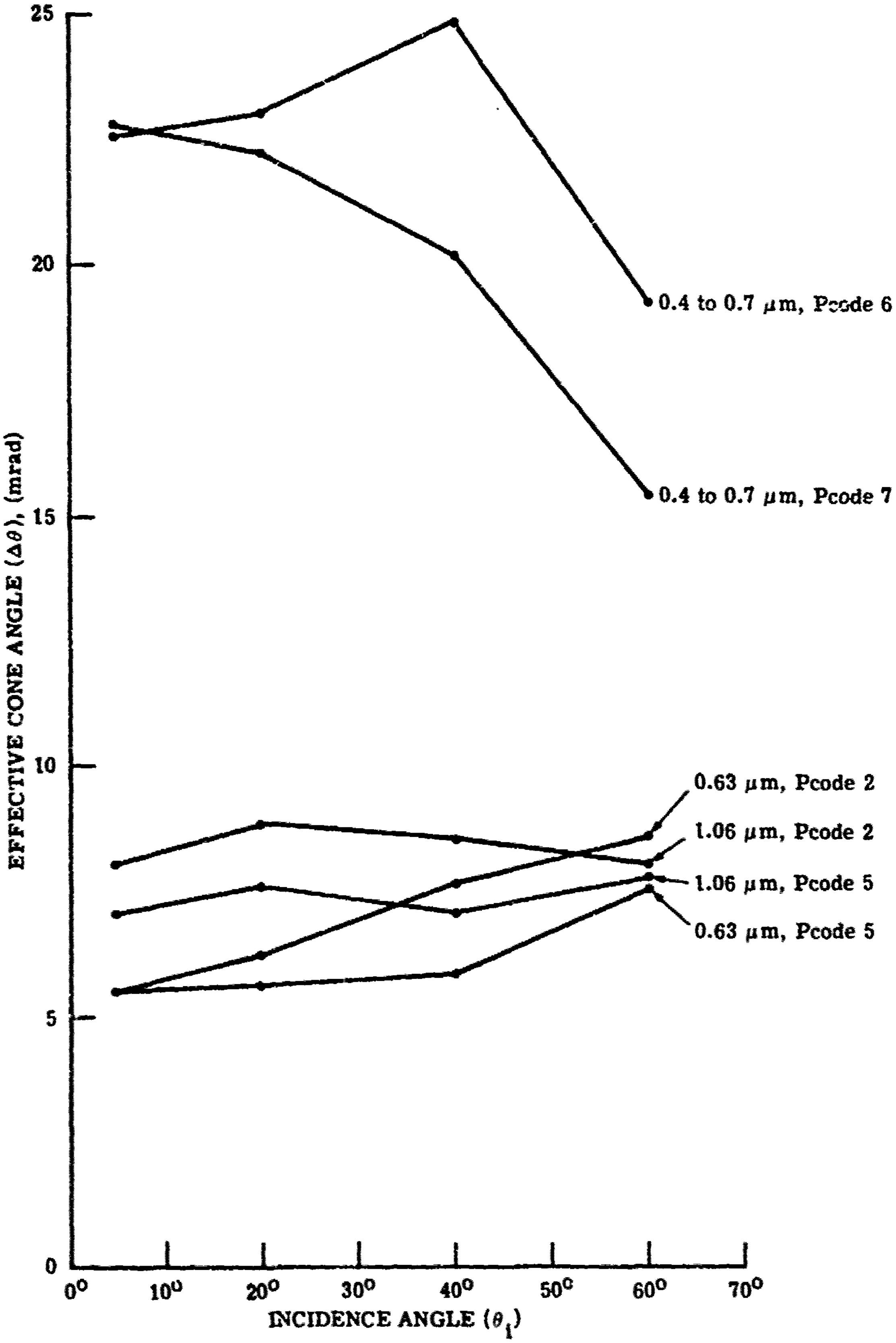


FIGURE 30. EFFECTIVE SOLAR CELL CONE ANGLE VERSUS INCIDENCE ANGLE (SAMPLE 3182), $\phi_1 = 0^{\circ}$

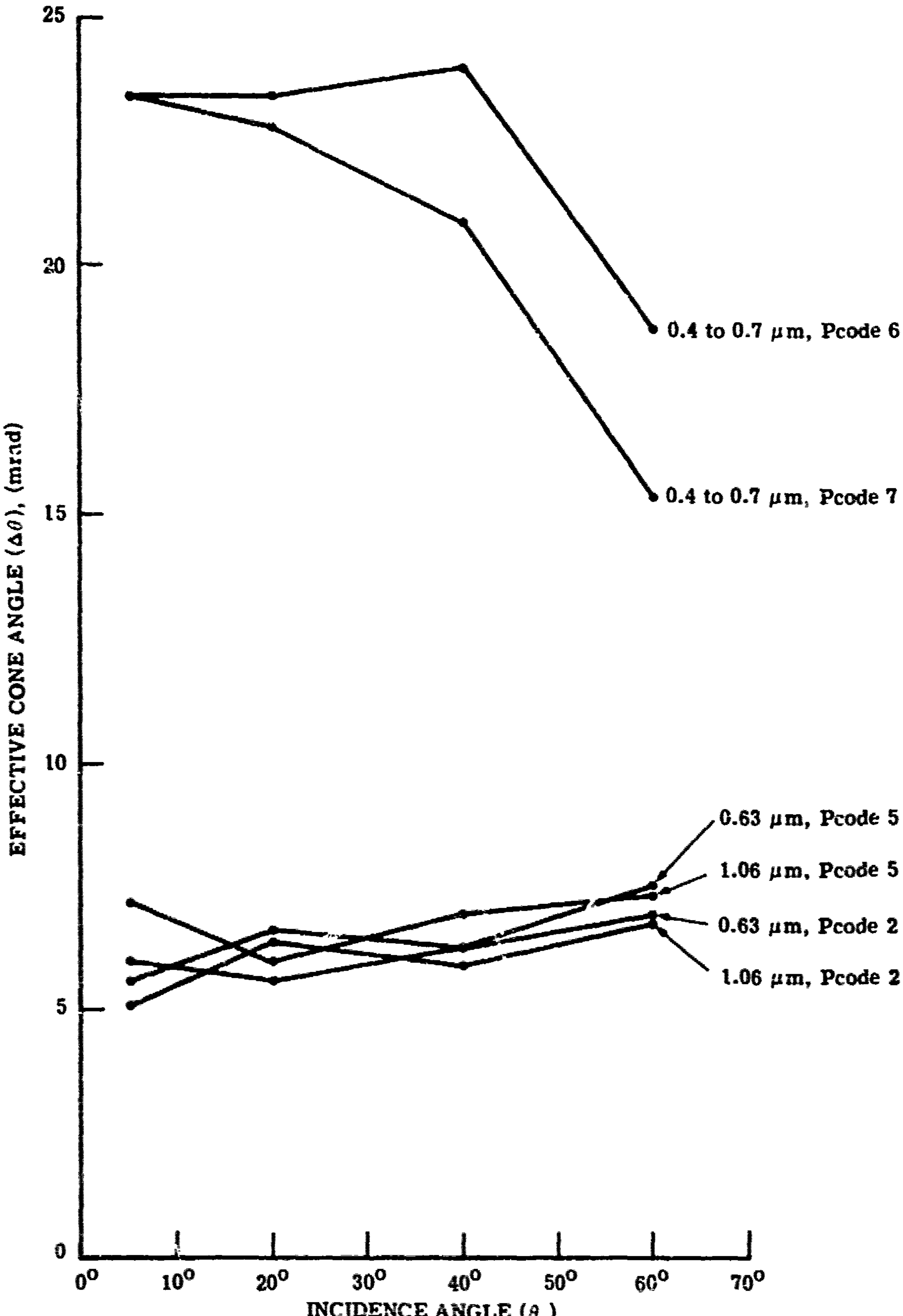


FIGURE 31. EFFECTIVE SOLAR CELL CONE ANGLE VERSUS INCIDENCE ANGLE (SAMPLE 3182), $\phi_i = 90^\circ$

the 0.4-1.0 μm wavelength band. These Eq ρ_d values have been put into four groups for averaging—C-type solar cells, first reflection; C-type solar cells, second reflection; H-type solar cells; and second-surface mirrors. The plots of average Eq $\rho_d \pm 1$ standard deviation (σ) are shown in Figs. 32 through 35. Single, unaveraged plots of measured ρ_d versus λ for samples from the same sample groups are shown, for comparison, in Figs. 36 through 38. There are differences in the ρ_d versus λ curves for the various samples in each group but mean and standard deviations have not been determined. Nevertheless, the plots shown reveal that ρ_d values in the visible region correspond very well with average Eq ρ_d values computed. For example, in Fig. 36, the C-type solar cells reflect 10 to 12%, and if the Eq ρ_d values from both Figs. 32 and 33 are added (to account for both reflection lobes), a value of about 12% is obtained. Likewise, the H-type solar cells reflect 8 to 12% and Fig. 34, which applies to only the stronger reflection lobe, shows an Eq ρ_d of about 7%. This last result indicates that even the H-type solar cells have a secondary reflection lobe or diffuse component of equal strength. It is known that a broad secondary lobe exists because diffuse areas were encountered during the measurements.

Measurements of ρ' for mirrors are very demanding of each system component and the measurement techniques; however, when the Eq ρ_d test was applied for the second-surface mirrors (Fig. 35), values just below 100% were obtained.

It is recognized that a rigorous computation is desirable in which the ρ_d versus λ for a specified or average sample are considered as well as the source and receiver relative spectral responses. Subsequently, a more rigorous computation for integration of the ρ' data would be desirable. The approximations employed here have been satisfactory, however, for the intended purposes—that is, for a preliminary interpretation and for establishment of confidence in the thousands of data points collected and processed. Certainly more studies would be performed on the existing basic data.

5.5. OBSERVATION ON C-TYPE SOLAR CELLS

At the beginning of the program it was found that the solar cells manufactured by Centralab (C-Type) exhibited two distinct, specularly reflected lobes. As mentioned in Section 5.4, there are also two reflections from Heliotek (H-Type) solar cells but the secondary lobe is more diffuse in nature. The difference may stem from the fact that Centralab uses a mechanical polishing method whereas Heliotek uses a chemical etch. No effort has been made to develop reflectance models for the two solar cell types, though some information may be obtained by study of the average Eq ρ_d versus θ_i curves in Figs. 32, 33 and 34. The shape of the curve, dipping at $\theta = 40^{\circ}$ and rising at $\theta = 60^{\circ}$, is the same for the H-Type cell in Fig. 34 and the secondary lobe of the C-Type cell in Fig. 33. These are both in sharp contrast to the first lobe of the C-Type cell in Fig. 32 where the curve starts higher and has an increasing downward slope out to 60°. The values plotted there are averages of 18 measurements, three cells each on 3 sample arrays observed along 2 orthogonal azimuth planes. Therefore, the trends of these curves with increasing incidence angle are significant. Similar trends were also found when working with

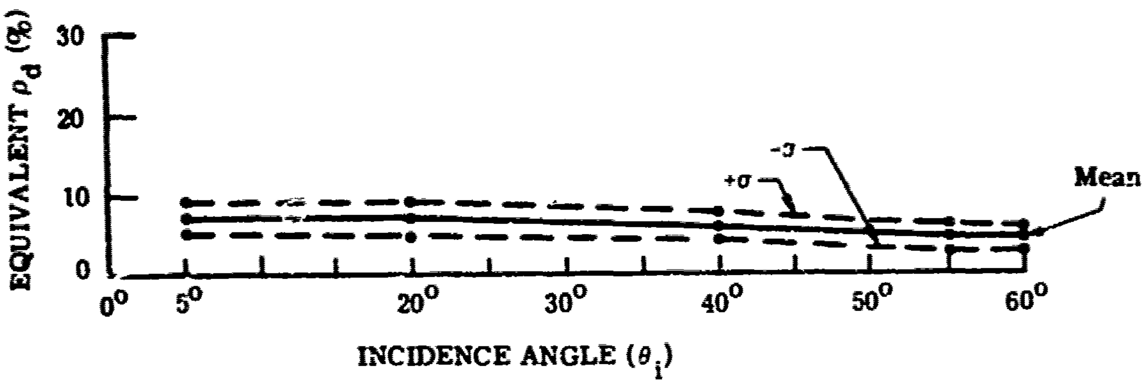


FIGURE 32. AVERAGED EQUIVALENT ρ_d VERSUS θ_i FOR C-TYPE SOLAR CELLS, FIRST REFLECTION. Nine cells from three samples averaged. $\lambda = 0.4\text{-}0.7\ \mu m$.

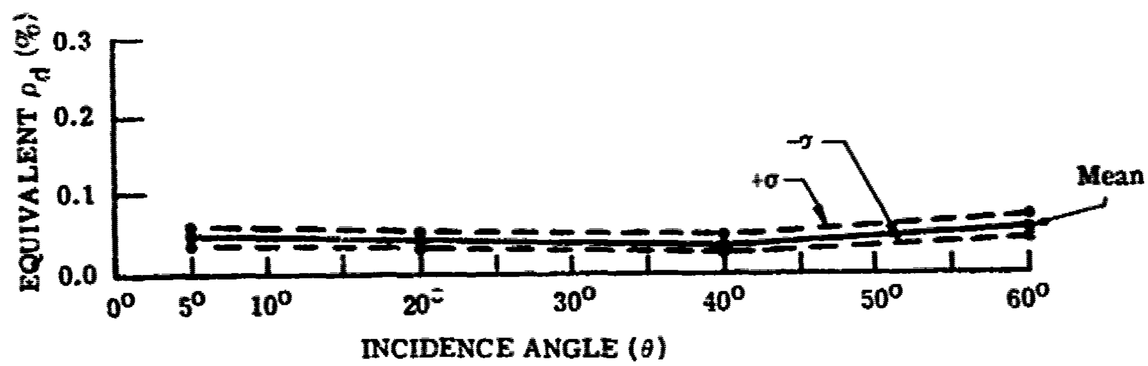


FIGURE 33. AVERAGED EQUIVALENT ρ_d VERSUS θ_i FOR C-TYPE SOLAR CELLS, SECOND REFLECTION. Nine cells from three samples averaged. $\lambda = 0.4\text{-}0.7\ \mu m$.

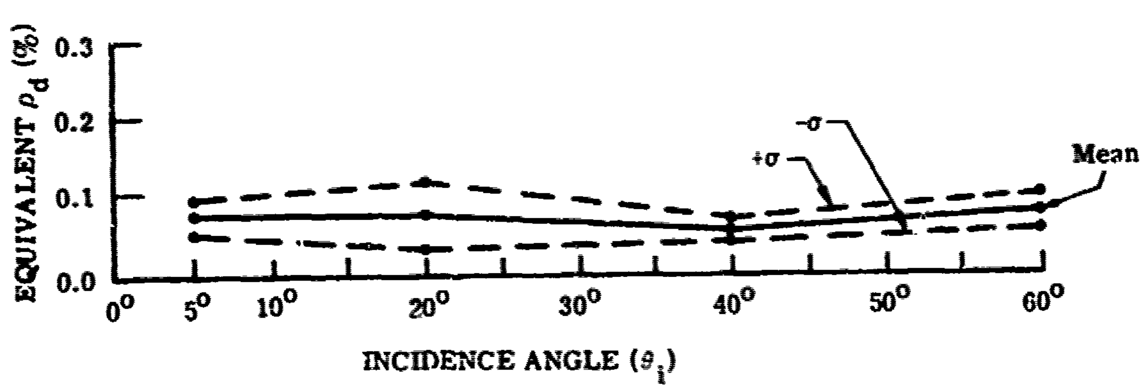


FIGURE 34. AVERAGED EQUIVALENT ρ_d VERSUS θ_i FOR H-TYPE SOLAR CELLS. Nine cells from three samples averaged. $\lambda = 0.4\text{-}0.7\ \mu m$.

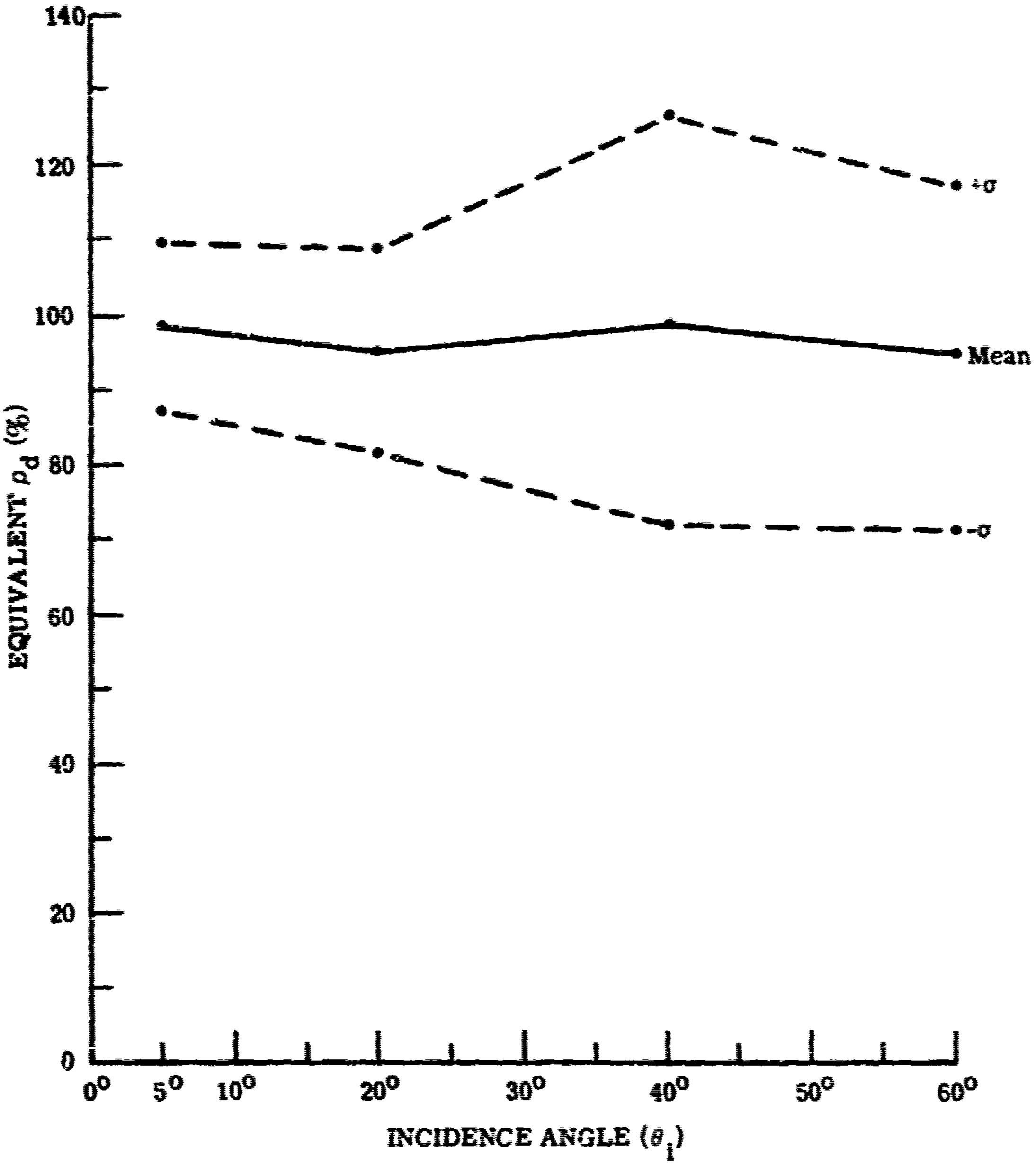


FIGURE 35. AVERAGED EQUIVALENT ρ_d VERSUS θ_i FOR SECOND-SURFACE MIRRORS. Nine mirrors from three samples averaged. $\lambda = 0.4\text{-}0.7\ \mu m$.

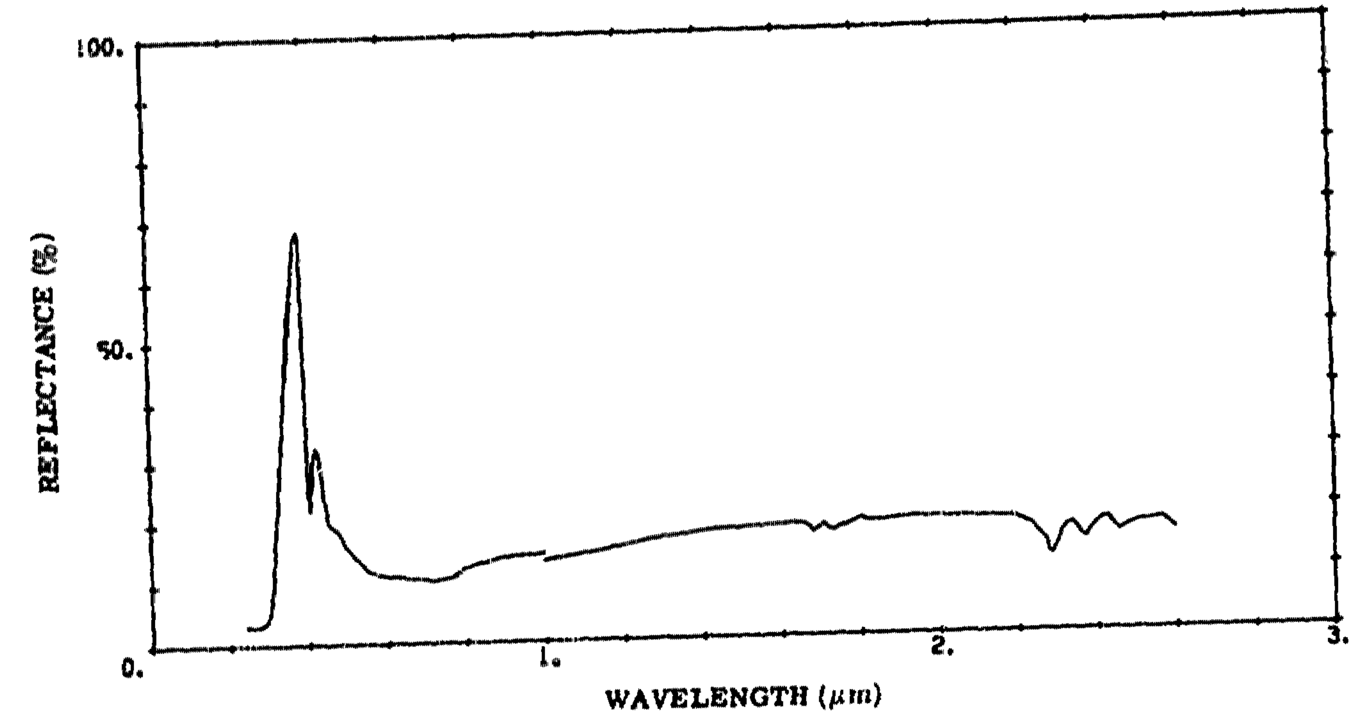


FIGURE 36. DIRECTIONAL REFLECTANCE VERSUS WAVELENGTH FOR C-TYPE SOLAR CELL (SAMPLE 3181)

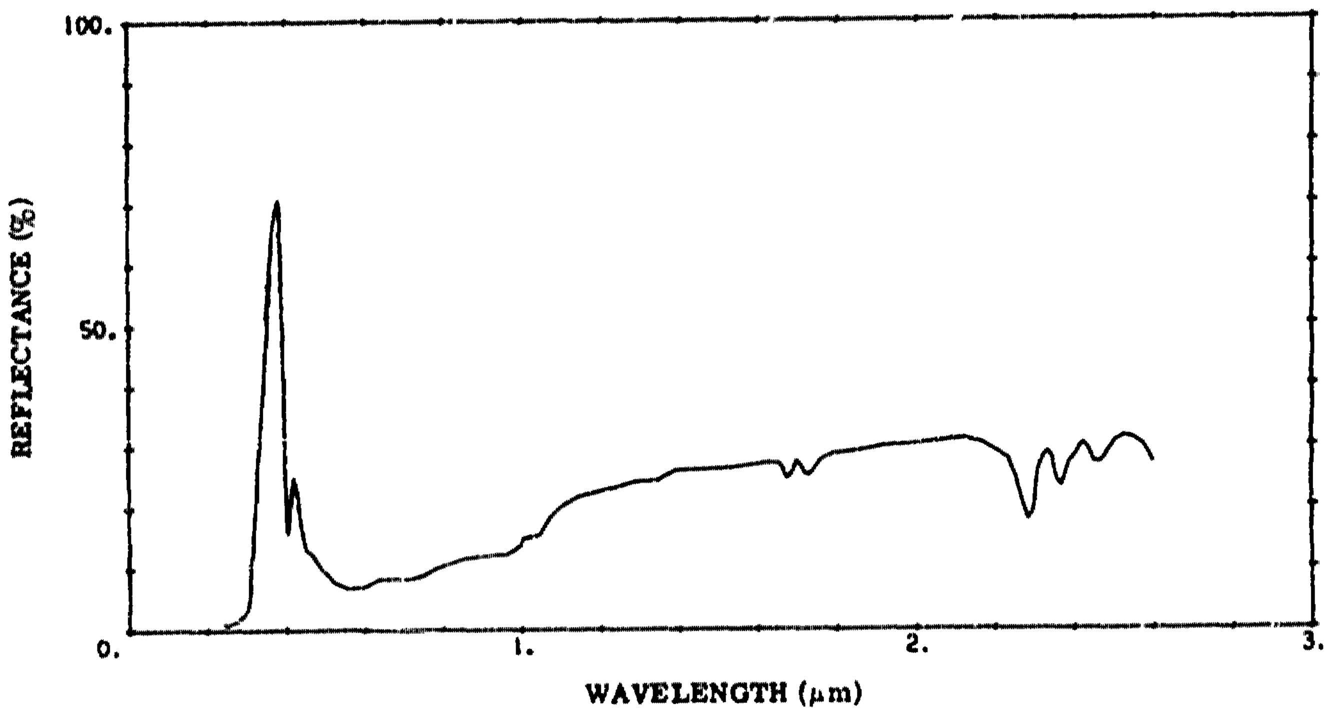


FIGURE 37. DIRECTIONAL REFLECTANCE VERSUS WAVELENGTH FOR H-TYPE SOLAR CELL (SAMPLE 3179)

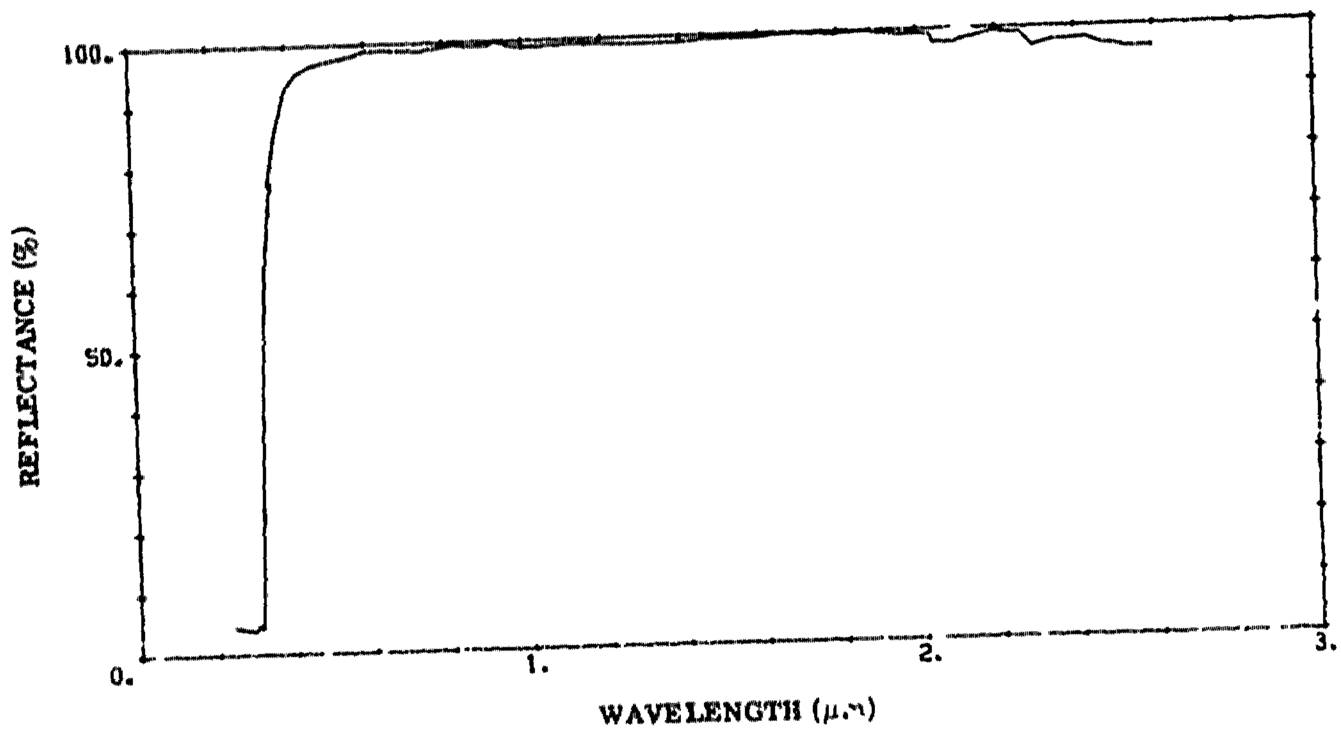


FIGURE 38. DIRECTIONAL REFLECTANCE VERSUS WAVELENGTH FOR SECOND-SURFACE MIRROR (SAMPLE 3165)

the laser sources at $\lambda = 0.63$ and $1.06\ \mu m$. The physical process responsible for the curve structure is not known at this time. It has been suggested that the first lobe, Fig. 32, is a reflection from the cover glass and the secondary lobe, Fig. 33, emanates from the interior of the solar cell which has the higher index of refraction. However, the physical implication behind this suggestion has not been analyzed.

During the measurements of the reflected matrices for the 0.4-0.7 μm band it was observed that the two reflections from the C-Type cells appeared to have slightly different colors. The secondary reflection usually appeared bluish whereas the first reflection was more white. This color differentiation was not very distinct but was used in assignment of the first and secondary reflection notation. Not until the data were all collected did the distinct angular properties become apparent.

5.6. COMBINED DIFFUSE AND SPECULAR DATA

The extremely specular nature of a solar cell is illustrated in Fig. 39. The data presented are a combined plot, taken from Appendices B and C respectively, of ρ' specular (bull's-eye representation) and ρ' diffuse data for the broadband visible source at an incidence angle of 40°. All ρ' values > 10 are from the bull's-eye, while those < 10 are from the ρ' diffuse data. Figure 40 is an expansion of Fig. 39 showing the region $\pm 7^{\circ}$ around the specular return. The stair-step portion of Fig. 40 is the bull's-eye representation of the data.

The transition from the diffuse to the specular portion of the plot shown in Fig. 40 is relatively smooth; however, it should be kept in mind that the diffuse portion of the curve close to the specular angle could be low as indicated in the section on instrumentation. The severity of the problem depends somewhat on the angular extent of the specular return. It is recalled that the broadband source had the largest $\Delta\theta$, therefore, one would expect the minimum error for the case illustrated.

In most cases, ρ' diffuse data only appears for a single azimuth (ϕ_i) plane. This is because initial measurements indicated an independence of the diffuse component with ϕ_i. Additional data was taken at the end of the measurements to verify that the decision was correct. Examination of the data for samples 3184-801 and 3184-802, as in Appendix C, shows greater variation than expected. It is difficult to determine, without further data evaluation, whether the original assessment was correct. These data are believed to be adequate for first-order assessment.

5.7 FIXED BISTATIC DATA AT 10.6 μm

Mainly because of limitations imposed by available instrumentation, the measurement technique at 10.6 μm was different from that at the shorter wavelengths. Fixed bistatic data with a small angle between the stationary source and receiver apply most directly to a radar-type application in which only backscattered power is of interest. For a specular type reflector, backscattered power exists only when the observation angle is very near the normal to the

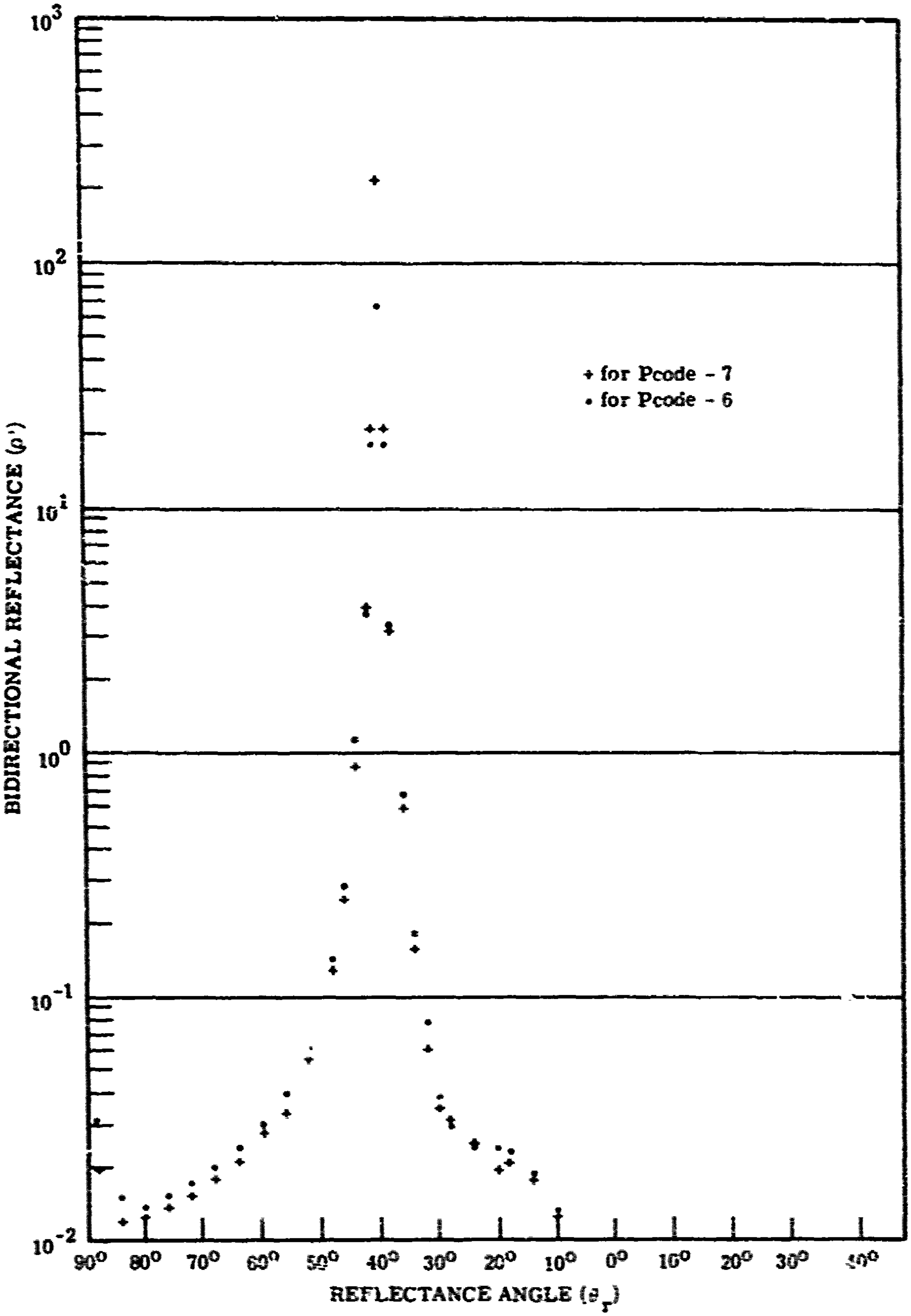


FIGURE 39. ρ' VERSUS θ_r FOR SOLAR CELL (SAMPLE 3182) WITH SPECULAR AND DIFFUSE COMPONENTS COMBINED. $\lambda = 0.4\text{-}0.7\ \mu m$; $\theta_i = 40°$.

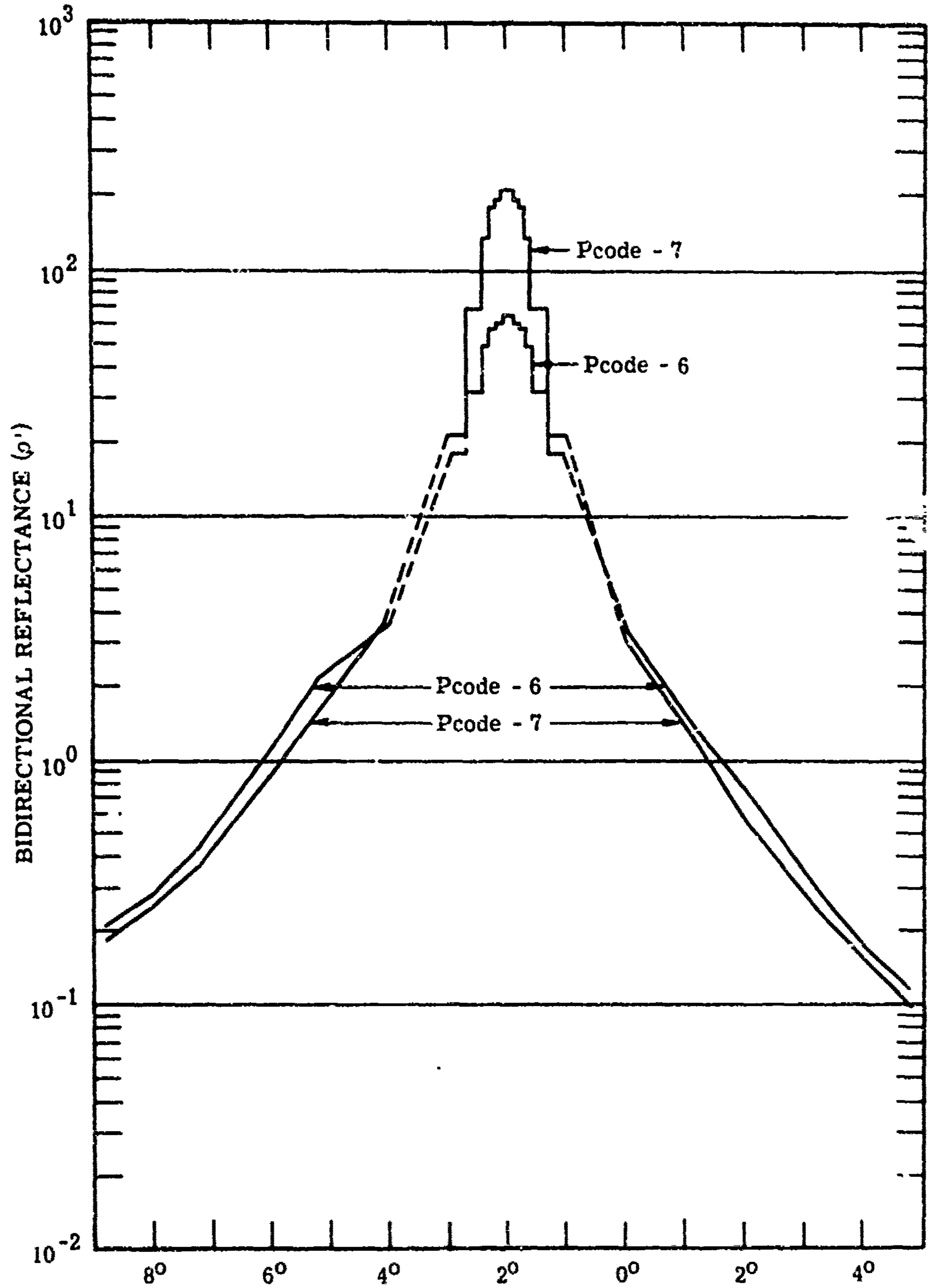


FIGURE 40. ρ' VERSUS θ_r FOR SOLAR CELL (SAMPLE 3182) WITH COMBINED SPECULAR AND DIFFUSE COMPONENTS EXPANDED AT SPECULAR ANGLE $\theta_r = 40^\circ$. $\lambda = 0.4\text{-}0.7\ \mu m$.

surface. Of course, diffuse reflectors have significant backscatter at all angles. Examples of the data collected have been plotted in Figs. 41 through 43 for an H-Type solar cell, a second-surface mirror, and a 3M black velvet paint.

As noted in Figs. 41 and 42, the mirror and solar cell data have ρ' values of similar magnitude. This is expected since both have opaque (at 10.6 μm) glass covers whose character should be the same. Angular data spread would differ because of surface curvature. The difference in the perpendicular and parallel data near the sample normal in Fig. 42 is likely the result of angular misalignment of the sample between data curves. (It was necessary to remove the sample between polarization runs to obtain angular dependence.)

The 3M black paint (Fig. 43) is relatively diffuse except at the specular normal where a narrow peak occurs. This may be from a small paint transmission through the paint, allowing the specular metal subsurface to be viewed. The paint data were inadvertently measured for only one polarization. Since the paints are relatively diffuse, experience shows that the opposite polarization for the small bistatic case would be the same. For this reason, no effort was made to obtain the missing data.

It should be noted that the fixed bistatic data were measured in only one, 0°, azimuth plane. Measurements in the 90° plane were not required since it is apparent that all the samples measured have azimuthal symmetry at 10.6 μm.

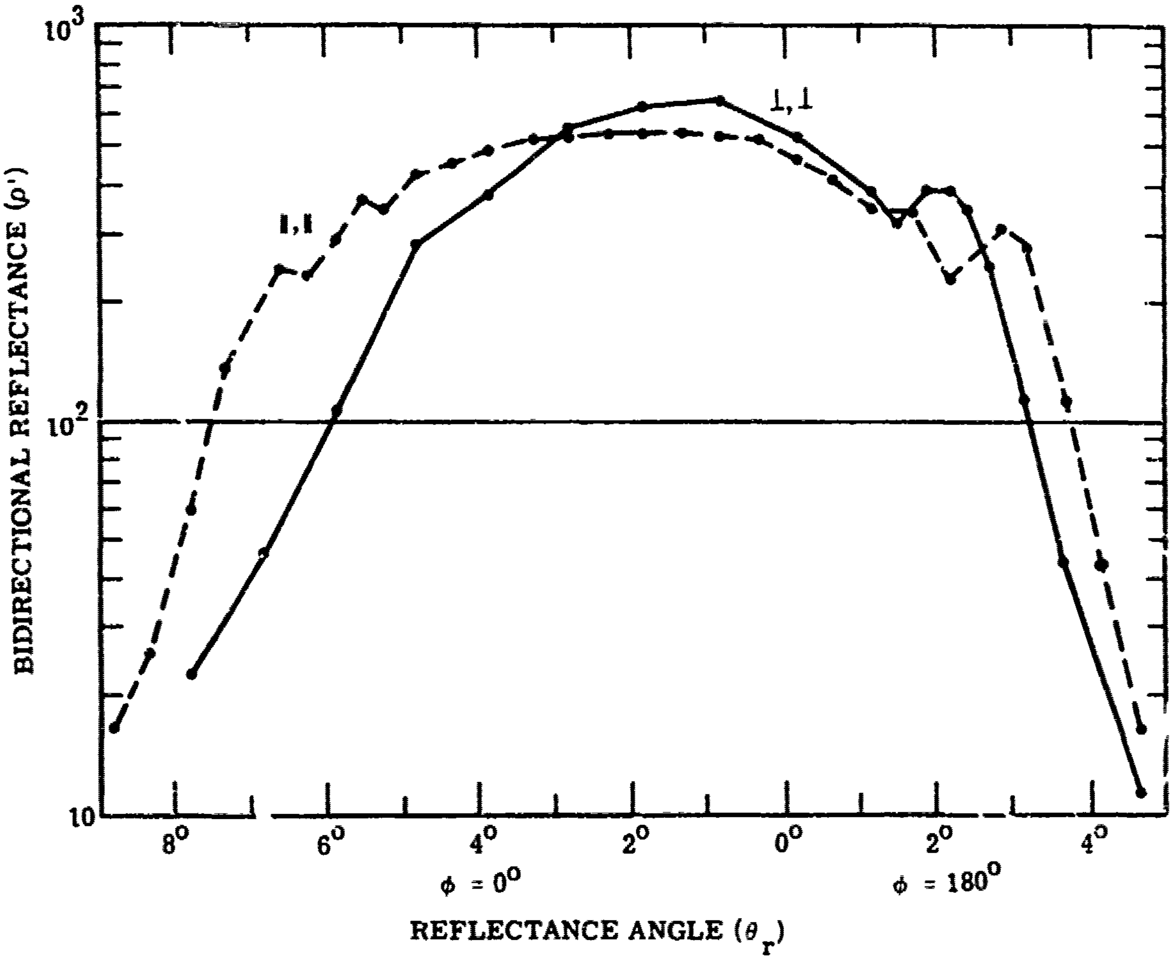


FIGURE 41. ρ' VERSUS θ_r FOR SOLAR CELL (SAMPLE 3182). $\lambda = 10.6\ \mu m$; fixed bistatic angle = 0.26°.

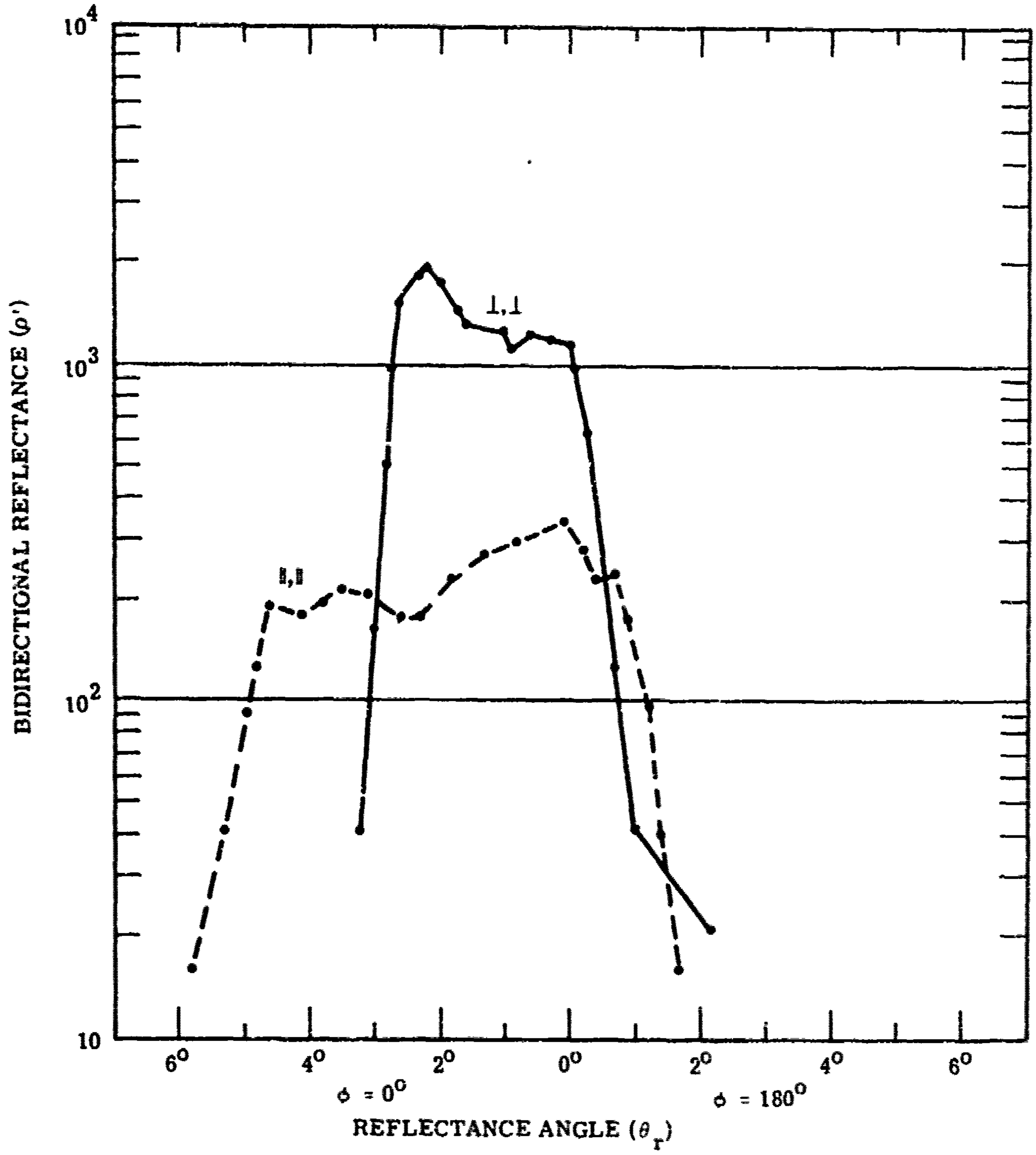


FIGURE 42. ρ' VERSUS θ_r FOR SECOND-SURFACE MIRROR (SAMPLE 3194). λ = 10.6 μm; fixed bistatic angle = 0.26°.

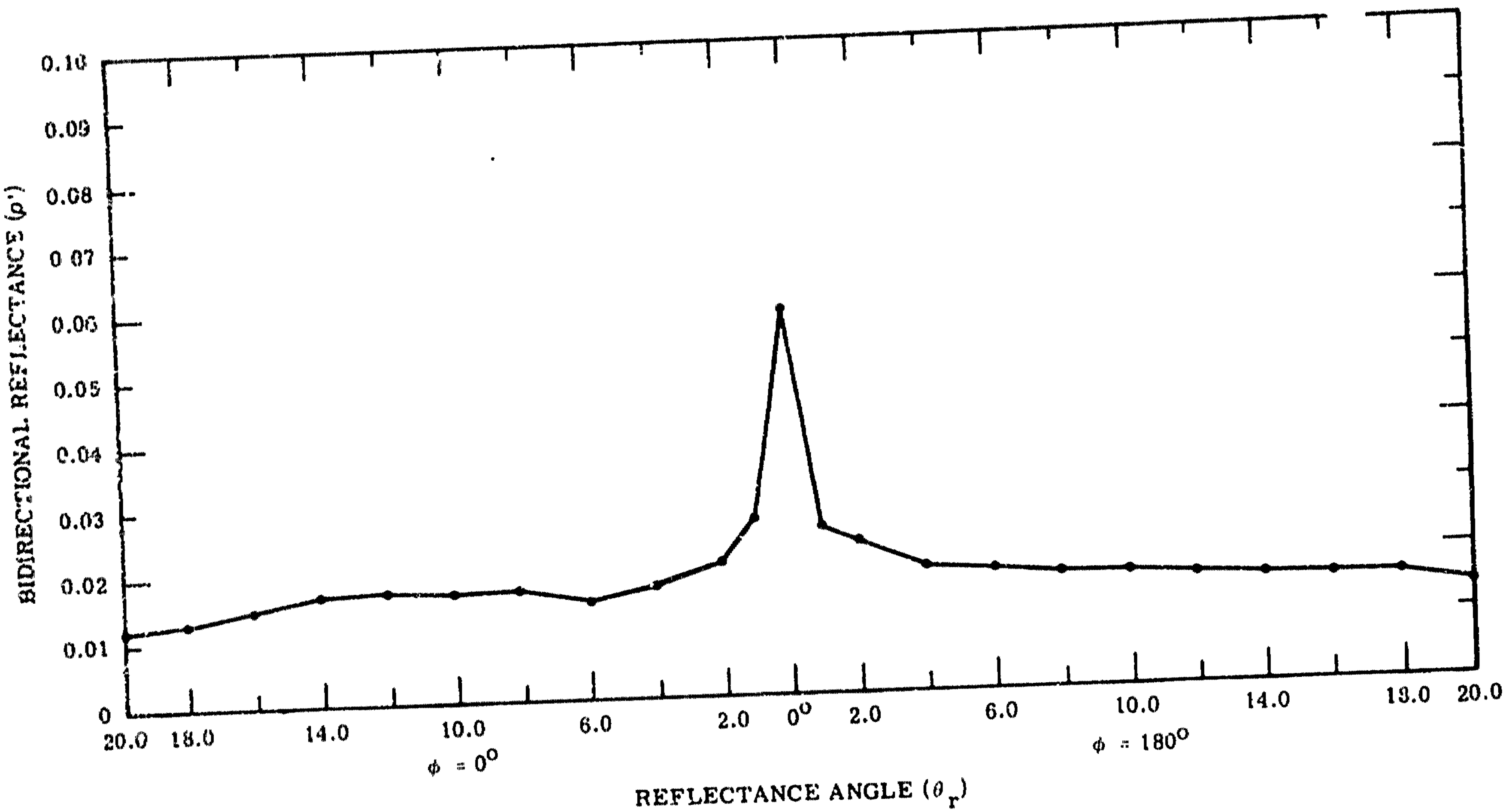


FIGURE 43. ρ' VERSUS θ_r FOR 3M BLACK PAINT (SAMPLE 3197). $\lambda = 10.6\ \mu m$; fixed bistatic angle = $0.26°$.

Appendix A
DIRECTION NORMALS

This appendix contains a computer listing of the direction normal data that were delivered to AVCO on computer cards. The assignment of the card columns is given in Table A-1. Because the data given are from a computer listing, some of the numbers are not separated by spaces, and as a result, the numbers appear to run together. The numbers can be distinguished by keeping in mind that the first two data values have four digits to the right of the decimal point and one to the left, while the latter three data values have two digits to the right of the decimal point and three to the left.

In the listing provided, the first data value given for each cell is the angle the cell normal makes with the substrate normal and is referred to as the zenith angle θ. The second data value is the azimuth angle (ϕ) of the cell normal projection on the plane of the substrate. The ϕ is measured counter-clockwise from the x-axis coordinate in the plane of the substrate. The ϕ reference is arbitrarily chosen and marked on each measurement sample. The third, fourth, and fifth data values are, respectively, the x, y, and z (range) positions of the cell normal, as measured with respect to projections into the substrate coordinate system. The last three values are redundant in that they can be easily obtained from the first two values, but are given here so that the standard deviations in the x and y directions can be more readily evaluated. All angular data values (θ and ϕ) are presented in radians, while all dimensional values (x, y and z) are given in centimeters.

It was necessary to treat the measurement and data reporting of the two 108-cell solar panels, sample numbers 3186 and 3187, somewhat differently because of their fabrication. Each 108-cell panel was assembled from three 36-cell arrays, each of which was shingled in a particular direction. However, the direction of the shingling for each element was alternated in the assembly: therefore each segment was treated as a separate sample. These are designated by an A, B, or C following the sample number given to the particular panel.

In Table A-2, a list of the samples measured and the order in which they appear in the listing is presented. All of the data shown here will be maintained in the ERIM library and available on cards or magnetic tape formats for future use.

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TABLE A-1. FORMAT DESCRIPTIONS

Card Columns	Description	Column Format Code
1-6	Sample number preceded by "AO"	X2, I4
7-9	Cell number	I3
11	A, B, or C, used to signify different segments on samples 3186 and 3187	A1
13	An X signifies the second specular reflection from the Centralab solar cells	A1
15	An A for Aerojet, C for Centralab, H for Heliotek and a T for TRW	A1
20-25	Zenith angle of cell normal	F6.4
26-31	Azimuth angle of cell normal	F6.4
32-37	X value of cell normal	F6.2
38-43	Y value of cell normal	F6 2
44-49	Distance from sample to the measurement plane of X and Y	F6.2

TABLE A-2. DIRECTION NORMAL MEASUREMENTS

Description	Sample No.	No. Cells	Prime	Mfg
Solar Cell Array, H-Type	3178	36		H
Solar Cell Array, H-Type	3179	36		H
Solar Cell Array, C-Type	3180	36		C
Solar Cell Array, C-Type	3180	36	X	C
Solar Cell Array, C-Type	3181	36		C
Solar Cell Array, C-Type	3181	36	X	C
Solar Cell Array, H-Type	3182	36		H
Solar Cell Array, H-Type	3183	36		H
Solar Cell Array, C-Type	3184	36		C
Solar Cell Array, C-Type	3184	36	X	C
Solar Cell Array, C-Type	3185	36		C
Solar Cell Array, C-Type	3185	36	X	C
Solar Cell Array, H-Type	3186	36A		H
Solar Cell Array, H-Type	3186	36B		H
Solar Cell Array, H-Type	3186	36C		H
Solar Cell Array, C-Type	3187	36A		C
Solar Cell Array, C-Type	3187	36B		C
Solar Cell Array, C-Type	3187	36C		C
Solar Cell Array, C-Type	3187	36A	X	C
Solar Cell Array, C-Type	3187	36B	X	C
Solar Cell Array, C-Type	3187	36C	X	C
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566)	3189	80		A
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566)	3190	80		A
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate RTV 566)	3191	80		A
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate RTV 566)	3192	80		A
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate RTV 566)	3193	80		A
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate,RTV 615 Backing)	3194	79		A
Aerojet 2nd Surface Mirror Array, Fiberglass Substrate,RTV 615 Backing)	3195	80		A
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate,RTV 615 Backing)	3196	80		A
Aerojet 2nd Surface Mirror Array, (IR Telescope Substrate,RTV 615 Backing)	3200	80		A
Aerojet 2nd Surface Mirror Array, (IR Telescope Substrate,RTV 615 Backing)	3201	80		A
Aerojet 2nd Surface Mirror Array, (IR Telescope Substrate,RTV 615 Backing)	3202	80		A

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y RANGE
A03178	1			H	.0187	.0425	14.92	.63800.00
A03178	2			H	.0121	.4049	8.89	3.81800.00
A03178	3			H	.0153	.6383	9.84	7.30800.00
A03178	4			H	.0253	6.0458	19.68	-4.76800.00
A03178	5			H	.0178	.2936	13.65	4.13800.00
A03178	6			H	.0224	.4795	15.87	8.25800.00
A03178	7			H	.0229	.4094	16.83	7.30800.00
A03178	8			H	.0115	.2450	8.89	2.22800.00
A03178	9			H	.0199	6.2233	15.87	-.95800.00
A03178	10			H	.0135	.7023	8.25	6.98800.00
A03178	11			H	.0148	6.1489	11.75	-1.59800.00
A03178	12			H	.0255	6.2052	20.32	-1.59800.00
A03178	13			H	.0104	6.1683	8.25	-.95800.00
A03178	14			H	.0132	.7217	7.94	6.98800.00
A03178	15			H	.0129	.7854	7.30	7.30800.00
A03178	16			H	.0299	5.9866	22.86	-6.98800.00
A03178	17			H	.0329	.3065	25.08	7.94800.00
A03178	18			H	.0206	.0192	16.51	.32800.00
A03178	19			H	.0311	1.0786	11.75	21.91800.00
A03178	20			H	.0157	.8211	8.57	9.21800.00
A03178	21			H	.0020	6.0858	1.59	-.32800.00
A03178	22			H	.0221	.6327	14.29	10.48800.00
A03178	23			H	.0067	.0000	5.40	.00800.00
A03178	24			H	.0115	.0345	9.21	.32800.00
A03178	25			H	.0161	6.1343	12.70	-1.90800.00
A03178	26			H	.0218	.0182	17.46	.32800.00
A03178	27			H	.0232	5.9344	17.46	-6.35800.00
A03178	28			H	.0237	.1514	18.73	2.86800.00
A03178	29			H	.0267	.1041	21.27	2.22800.00
A03178	30			H	.0134	6.0742	10.48	-2.22800.00
A03178	31			H	.0274	5.8650	20.00	-8.89800.00
A03178	32			H	.0206	.5934	13.65	9.21800.00
A03178	33			H	.0252	.1263	20.00	2.54800.00
A03178	34			H	.0210	5.3635	10.16	-13.33800.00
A03178	35			H	.0289	.3218	21.91	7.30800.00
A03178	36			H	.0233	.7734	13.33	13.02800.00
A03179	1			H	.0199	.0599	15.87	.95800.00
A03179	2			H	.0107	.6805	6.67	5.40800.00
A03179	3			H	.0249	.8985	12.38	15.56800.00
A03179	4			H	.0258	.0461	20.64	.95800.00
A03179	5			H	.0237	.2368	18.41	4.44800.00
A03179	6			H	.0292	.8046	16.19	16.83800.00
A03179	7			H	.0274	6.1085	21.59	-3.81800.00
A03179	8			H	.0315	.0884	25.08	2.22800.00
A03179	9			H	.0343	.3547	25.72	9.52800.00
A03179	10			H	.0320	.2510	24.76	6.35800.00
A03179	11			H	.0217	.1651	17.14	2.86800.00
A03179	12			H	.0256	.4845	18.10	9.52800.00
A03179	13			H	.0240	.5972	15.87	10.79800.00
A03179	14			H	.0222	.0357	17.78	.63800.00
A03179	15			H	.0255	.5404	17.46	10.48800.00
A03179	16			H	.0272	5.5287	15.87	-14.92800.00
A03179	17			H	.0328	.3715	24.45	9.52800.00
A03179	18			H	.0229	.6747	14.29	11.43800.00
A03179	19			H	.0045	2.2318	-2.22	2.86800.00
A03179	20			H	.0037	.7086	2.22	1.90800.00
A03179	21			H	.0137	1.8650	-3.17	10.48800.00
A03179	22			H	.0108	5.7868	7.62	-4.13800.00
A03179	23			H	.0206	.0192	16.51	.32800.00
A03179	24			H	.0165	.4744	11.75	6.03800.00
A03179	25			H	.0212	5.9792	16.19	-5.08800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	○	X	Y	RANGE
A03179	26			H	.0230	.0517	18.41	.95	800.00
A03179	27			H	.0237	.3059	18.10	5.71	800.00
A03179	28			H	.0254	5.6084	15.87	-12.70	800.00
A03179	29			H	.0183	6.0645	14.29	-3.17	800.00
A03179	30			H	.0227	.2111	17.78	3.81	800.00
A03179	31			H	.0208	5.6740	13.65	-9.52	800.00
A03179	32			H	.0103	5.8023	7.30	-3.81	800.00
A03179	33			H	.0241	.4416	17.46	8.25	800.00
A03179	34			H	.0275	5.7873	19.37	-10.48	800.00
A03179	35			H	.0262	5.9758	20.00	-6.35	800.00
A03179	36			H	.0259	.3120	[illegible]	[illegible]	800.00
A03180	1			C	.0328	5.9117	24.45	-9.52	800.00
A03180	2			C	.0267	6.1791	21.27	-2.22	800.00
A03180	3			C	.0254	.5056	17.78	9.84	800.00
A03180	4			C	.0262	5.9280	19.68	-7.30	800.00
A03180	5			C	.0278	6.2689	22.22	-.32	800.00
A03180	6			C	.0360	.2904	27.62	8.25	800.00
A03180	7			C	.0377	6.1458	29.84	-4.13	800.00
A03180	8			C	.0246	.0322	19.68	.63	800.00
A03180	9			C	.0349	.2643	26.99	7.30	800.00
A03180	10			C	.0297	6.1356	23.49	-3.49	800.00
A03180	11			C	.0275	.1011	21.91	2.22	800.00
A03180	12			C	.0370	.2606	28.57	7.62	800.00
A03180	13			C	.0279	6.2119	22.22	-1.59	800.00
A03180	14			C	.0283	6.1849	22.54	-2.22	800.00
A03180	15			C	.0409	6.2347	32.70	-1.59	800.00
A03180	16			C	.0357	6.2499	28.57	-.95	800.00
A03180	17			C	.0410	6.1960	32.70	-2.86	800.00
A03180	18			C	.0458	6.1878	36.51	-3.49	800.00
A03180	19			C	.0200	.1194	15.87	1.90	800.00
A03180	20			C	.0247	.4133	18.10	7.94	800.00
A03180	21			C	.0225	5.8274	16.19	-7.94	800.00
A03180	22			C	.0318	6.2208	25.40	-1.59	800.00
A03180	23			C	.0302	.4636	21.59	10.79	800.00
A03180	24			C	.0321	.2120	25.08	5.40	800.00
A03180	25			C	.0270	6.2538	21.59	-.63	800.00
A03180	26			C	.0256	.2826	19.68	5.71	800.00
A03180	27			C	.0292	.3905	21.59	8.89	800.00
A03180	28			C	.0306	6.2572	24.45	-.63	800.00
A03180	29			C	.0318	.3178	24.13	7.94	800.00
A03180	30			C	.0399	.4636	28.57	14.29	800.00
A03180	31			C	.0227	6.1957	18.10	-1.59	800.00
A03180	32			C	.0244	.5292	16.83	9.84	800.00
A03180	33			C	.0276	.8871	13.97	17.14	800.00
A03180	34			C	.0376	.1912	29.53	5.71	800.00
A03180	35			C	.0430	.2808	33.02	9.52	800.00
A03180	36			C	.0391	.8501	20.64	23.49	800.00
A03180	1		X	C	.0225	5.8274	16.19	-7.94	800.00
A03180	2		X	C	.0209	.1714	16.51	2.86	800.00
A03180	3		X	C	.0256	.8184	13.97	14.92	800.00
A03180	4		X	C	.0284	5.9261	21.27	-7.94	800.00
A03180	5		X	C	.0234	.0339	18.73	.63	800.00
A03180	6		X	C	.0360	.2904	27.62	8.25	800.00
A03180	7		X	C	.0319	5.9142	23.81	-9.21	800.00
A03180	8		X	C	.0264	.1206	20.95	2.54	800.00
A03180	9		X	C	.0248	6.1549	19.68	-2.54	800.00
A03180	10		X	C	.0320	6.1465	25.40	-3.49	800.00
A03180	11		X	C	.0278	.0000	22.22	.00	800.00
A03180	12		X	C	.0323	.2867	24.76	7.30	800.00
A03180	13		X	C	.0338	6.1180	26.67	-4.44	800.00
A03180	14		X	C	.0219	.0907	17.46	1.59	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03180	15		X	C	.0398	.0699	31.75	2.22	800.00
A03180	16		X	C	.0286	5.9877	21.91	-6.67	800.00
A03180	17		X	C	.0311	6.1937	24.76	-2.22	800.00
A03180	18		X	C	.0416	6.1008	32.70	-6.03	800.00
A03180	19		X	C	.0135	.0294	10.79	.32	800.00
A03180	20		X	C	.0272	.2202	21.27	4.76	800.00
A03180	21		X	C	.0173	5.6443	11.11	-8.25	800.00
A03180	22		X	C	.0187	.0849	14.92	1.27	800.00
A03180	23		X	C	.0217	.2405	16.83	4.13	800.00
A03180	24		X	C	.0233	.3110	17.78	5.71	800.00
A03180	25		X	C	.0239	.2007	18.73	3.81	800.00
A03180	26		X	C	.0215	.5880	14.29	9.52	800.00
A03180	27		X	C	.0390	.2573	30.16	7.94	800.00
A03180	28		X	C	.0312	.1275	24.76	3.17	800.00
A03180	29		X	C	.0223	.3838	16.51	6.67	800.00
A03180	30		X	C	.0399	.4636	28.57	14.29	800.00
A03180	31		X	C	.0191	.0624	15.24	.95	800.00
A03180	32		X	C	.0138	.7243	8.25	7.30	800.00
A03180	33		X	C	.0306	.6565	19.37	14.92	800.00
A03180	34		X	C	.0348	6.1687	27.62	-3.17	800.00
A03180	35		X	C	.0310	.3663	23.18	8.89	800.00
A03180	36		X	C	.0449	.7979	25.08	25.72	800.00
A03181	1			C	.0259	5.9226	19.37	-7.30	800.00
A03181	2			C	.0061	5.7315	4.13	-2.54	800.00
A03181	3			C	.0139	.4124	10.16	4.44	800.00
A03181	4			C	.0339	5.9244	25.40	-9.52	800.00
A03181	5			C	.0297	5.9572	22.54	-7.62	800.00
A03181	6			C	.0280	.1138	22.22	2.54	800.00
A03181	7			C	.0302	3.8489	21.91	-10.16	800.00
A03181	8			C	.0207	6.2064	16.51	-1.27	800.00
A03181	9			C	.0270	6.0311	20.95	-5.40	800.00
A03181	10			C	.0252	5.8618	18.41	-8.25	800.00
A03181	11			C	.0247	.0965	19.68	1.90	800.00
A03181	12			C	.0262	.0303	20.95	.63	800.00
A03181	13			C	.0302	5.8783	22.22	-9.52	800.00
A03181	14			C	.0263	6.1925	20.95	-1.90	800.00
A03181	15			C	.0294	6.2157	23.49	-1.59	800.00
A03181	16			C	.0292	5.6424	18.73	-13.97	800.00
A03181	17			C	.0218	.1831	17.14	3.17	800.00
A03181	18			C	.0176	.1355	13.97	1.90	800.00
A03181	19			C	.0157	5.5335	9.21	-8.57	800.00
A03181	20			C	.0024	1.4056	.32	1.90	800.00
A03181	21			C	.0225	1.1150	7.94	16.19	800.00
A03181	22			C	.0307	5.8427	22.22	-10.48	800.00
A03181	23			C	.0339	6.1893	26.9[illegible]	-2.54	800.00
A03181	24			C	.0358	.2692	27.62	7.62	800.00
A03181	25			C	.0291	5.9356	21.91	-7.94	800.00
A03181	26			C	.0242	.0328	19.37	.63	800.00
A03181	27			C	.0318	.2783	24.45	6.98	800.00
A03181	28			C	.0280	6.0107	21.59	-5.03	800.00
A03181	29			C	.0259	6.1911	20.64	-1.90	800.00
A03181	30			C	.0291	.3045	22.22	6.98	800.00
A03181	31			C	.0208	5.9735	15.87	-5.08	800.00
A03181	32			C	.0216	.1107	17.14	1.90	800.00
A03181	33			C	.0205	.6202	13.33	9.52	800.00
A03181	34			C	.0348	6.0299	26.99	-6.98	800.00
A03181	35			C	.0437	.0273	34.92	.95	800.00
A03181	36			C	.0517	.1853	40.64	7.62	800.00
A03181	1		X	C	.0285	5.6759	18.73	-13.02	800.00
A03181	2		X	C	.0183	6.0645	14.29	-3.17	800.00
A03181	3		X	C	.0156	.1275	12.38	1.59	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03181	4		X	C	.0265	5.7994	18.73	-9.84	800.00
A03181	5		X	C	.0266	6.2236	21.27	-1.27	800.00
A03181	6		X	C	.0337	.0235	26.99	.63	800.00
A03181	7		X	C	.0237	5.7370	16.19	-9.84	800.00
A03181	8		X	C	.0241	5.9823	18.41	-5.71	800.00
A03181	9		X	C	.0282	.0563	22.54	1.27	800.00
A03181	10		X	C	.0265	5.7325	18.10	-11.11	800.00
A03181	11		X	C	.0227	.1049	18.10	1.90	800.00
A03181	12		X	C	.0232	5.9344	17.46	-6.35	800.00
A03181	13		X	C	.0223	5.7001	14.92	-9.84	800.00
A03181	14		X	C	.0253	.1574	20.00	3.17	800.00
A03181	15		X	C	.0240	.1326	19.05	2.54	800.00
A03181	16		X	C	.0222	5.4346	11.75	-13.33	800.00
A03181	17		X	C	.0145	.1651	11.43	1.90	800.00
A03181	18		X	C	.0179	.4340	13.02	6.03	800.00
A03181	19		X	C	.0131	5.2166	9.08	-9.21	800.00
A03181	20		X	C	.0057	3.3527	-4.44	-.95	800.00
A03181	21		X	C	.0188	1.3361	3.49	14.60	800.00
A03181	22		X	C	.0307	5.8427	22.22	-10.48	800.00
A03181	23		X	C	.0310	6.1159	24.45	-4.13	800.00
A03181	24		X	C	.0350	.1707	27.62	4.76	800.00
A03181	25		X	C	.0330	5.9652	25.08	-8.25	800.00
A03181	26		X	C	.0250	5.9765	19.05	-6.03	800.00
A03181	27		X	C	.0262	.2450	20.32	5.08	800.00
A03181	28		X	C	.0270	5.0590	19.68	-8.89	800.00
A03181	29		X	C	.0204	.1171	16.19	1.90	800.00
A03181	30		X	C	.0232	.2947	17.78	5.40	800.00
A03181	31		X	C	.0249	5.7838	17.46	-9.52	800.00
A03181	32		X	C	.0246	.0161	19.68	.32	800.00
A03181	33		X	C	.0207	.3520	15.56	5.71	800.00
A03181	34		X	C	.0360	5.8392	26.03	-12.38	600.00
A03181	35		X	C	.0427	6.1900	33.97	-3.17	600.00
A03181	36		X	C	.0515	.3218	39.05	13.02	800.00
A03182	1			H	.0137	1.9567	-4.13	10.16	800.00
A03182	2			H	.0091	1.1659	2.86	6.67	800.00
A03182	3			H	.0127	4.6500	-.63	-10.16	800.00
A03182	4			H	.0247	.4852	17.46	9.21	800.00
A03182	5			H	.0243	.1974	19.05	3.81	800.00
A03182	6			H	.0275	5.8518	20.00	-9.21	800.00
A03182	7			H	.0256	.4151	18.73	8.25	800.00
A03182	8			H	.0244	.5655	16.51	10.48	800.00
A03182	9			H	.0237	5.8871	17.46	-7.30	800.00
A03182	10			H	.0203	6.2440	16.19	-.63	800.00
A03182	11			H	.0181	.4538	13.02	6.35	800.00
A03182	12			H	.0204	5.7761	14.29	-7.94	800.00
A03182	13			H	.0160	.2510	12.38	3.17	800.00
A03182	14			H	.0222	.2709	17.14	4.76	800.00
A03182	15			H	.0263	6.0858	20.64	-4.13	800.00
A03182	16			H	.0303	.2513	23.49	6.03	800.00
A03182	17			H	.0338	.0588	26.99	1.59	800.00
A03182	18			H	.0235	.2737	18.10	5.08	800.00
A03182	19			H	.0231	1.0304	9.52	15.87	800.00
A03182	20			H	.0183	5.8098	13.02	-6.67	800.00
A03182	21			H	.0187	4.7124	.00	-14.92	800.00
A03182	22			H	.0268	.3640	20.00	7.62	800.00
A03182	23			H	.0243	.2648	18.73	5.08	800.00
A03182	24			H	.0237	5.6163	14.92	-11.75	800.00
A03182	25			H	.0210	.5145	14.60	8.25	800.00
A03182	26			H	.0172	5.8298	12.38	-6.03	800.00
A03182	27			H	.0181	5.8783	13.33	-5.71	800.00
A03182	28			H	.0181	.1543	14.29	2.22	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	[illegible]	[illegible]	X	Y	RANGE
A03182	29			H	.0156	.1275	12.38	1.59	800.00
A03182	30			H	.0166	5.5486	9.84	-8.89	800.00
A03182	31			H	.0230	.1906	18.10	3.49	800.00
A03182	32			H	.0175	.0681	13.97	.95	800.00
A03182	33			H	.0221	6.1210	17.46	-2.86	800.00
A03182	34			H	.0358	6.2398	28.57	-1.27	800.00
A03182	35			H	.0338	.0588	26.99	1.59	800.00
A03182	36			H	.0297	6.0674	23.18	-5.08	800.00
A03183	1			H	.0061	1.3734	.95	4.76	800.00
A03183	2			H	.0053	1.1071	1.90	3.81	800.00
A03183	3			H	.0086	4.4786	-1.59	-6.67	800.00
A03183	4			H	.0245	.2450	19.05	4.76	800.00
A03183	5			H	.0286	6.2693	22.86	-.32	800.00
A03183	6			H	.0286	6.2554	22.86	-.63	800.00
A03183	7			H	.0300	.3510	22.54	8.25	800.00
A03183	8			H	.0211	.0941	16.83	1.59	800.00
A03183	9			H	.0337	6.0211	26.03	-6.98	800.00
A03183	10			H	.0220	.4073	16.19	6.98	800.00
A03183	11			H	.0184	.1083	14.60	1.59	800.00
A03183	12			H	.0181	5.8783	13.33	-5.71	800.00
A03183	13			H	.0232	6.1461	18.41	-2.54	800.00
A03183	14			H	.0113	6.1065	8.89	-1.59	800.00
A03183	15			H	.0218	5.8114	15.56	-7.94	800.00
A03183	16			H	.0294	6.2697	23.49	-.32	800.00
A03183	17			H	.0357	6.2610	28.57	-.63	800.00
A03183	18			H	.0323	6.0352	25.08	-6.35	800.00
A03183	19			H	.0186	.5880	12.38	8.25	800.00
A03183	20			H	.0171	.0233	13.65	.32	800.00
A03183	21			H	.0249	5.0038	5.71	-19.05	800.00
A03183	22			H	.0198	6.1015	15.56	-2.86	800.00
A03183	23			H	.0217	6.0427	16.83	-4.13	800.00
A03183	24			H	.0295	5.9402	22.22	-7.94	800.00
A03183	25			H	.0153	5.9942	11.75	-3.49	800.00
A03183	26			H	.0124	.1233	9.84	1.27	800.00
A03183	27			H	.0214	5.7364	14.60	-8.89	800.00
A03183	28			H	.0238	.1843	18.73	3.49	800.00
A03183	29			H	.0183	.0651	14.60	.95	800.00
A03183	30			H	.0142	5.9703	10.79	-3.49	800.00
A03183	31			H	.0227	6.1783	18.10	-1.90	800.00
A03183	32			H	.0284	5.9261	21.27	-7.94	800.00
A03183	33			H	.0255	6.1697	20.32	-1.90	800.00
A03183	34			H	.0310	.0000	24.76	.00	800.00
A03183	35			H	.0284	6.1571	22.54	-2.86	800.00
A03183	36			H	.0294	6.2292	23.49	-1.27	800.00
A03184	1			C	.0159	1.0175	6.67	10.79	800.00
A03184	2			C	.0140	6.1694	11.11	-1.27	800.00
A03184	3			C	.0273	5.5698	16.51	-14.29	800.00
A03184	4			C	.0430	.1576	33.97	5.40	800.00
A03184	5			C	.0397	6.2732	31.75	-.32	800.00
A03184	6			C	.0446	5.9755	33.97	-10.79	800.00
A03184	7			C	.0346	.2533	26.99	6.98	800.00
A03184	8			C	.0258	6.2371	20.64	-.95	800.00
A03184	9			C	.0335	5.9203	25.08	-9.52	800.00
A03184	10			C	.0321	.3530	24.13	8.89	800.00
A03184	11			C	.0274	6.2397	21.91	-.95	800.00
A03184	12			C	.0365	6.0303	28.26	-7.30	800.00
A03184	13			C	.0304	.3465	22.86	8.25	800.00
A03184	14			C	.0281	.1419	22.22	3.17	800.00
A03184	15			C	.0248	6.0732	19.37	-4.13	800.00
A03184	16			C	.0462	.0774	36.83	2.86	800.00
A03184	17			C	.0384	6.1588	30.48	-3.81	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	ϕ	X	Y	RANGE
A03184	18			C	.0275	.0723	21.91	1.59	800.00
A03184	19			C	.0334	.7434	19.68	18.10	800.00
A03184	20			C	.0197	.1618	15.56	2.54	800.00
A03184	21			C	.0263	5.1490	8.89	-19.05	800.00
A03184	22			C	.0317	.3852	23.49	9.52	800.00
A03184	23			C	.0266	.0298	21.27	.63	800.00
A03184	24			C	.0304	5.9780	23.18	-7.30	800.00
A03184	25			C	.0325	.4691	23.18	11.75	800.00
A03184	26			C	.0211	.0565	16.83	.95	800.00
A03184	27			C	.0343	5.9651	26.03	-8.57	800.00
A03184	28			C	.0317	.3852	23.49	9.52	800.00
A03184	29			C	.0223	.1974	17.46	3.49	800.00
A03184	30			C	.0338	5.9726	25.72	-8.25	800.00
A03184	31			C	.0298	.2838	22.86	6.67	800.00
A03184	32			C	.0258	.0461	20.64	.95	800.00
A03184	33			C	.0339	5.9614	25.72	-8.57	800.00
A03184	34			C	.0452	.2301	35.24	8.25	800.00
A03184	35			C	.0520	.0153	41.59	.63	800.00
A03184	36			C	.0503	6.0765	39.37	-8.25	800.00
A03184	1		X	C	.0092	1.1264	3.17	6.67	800.00
A03184	2		X	C	.0104	.3097	7.94	2.54	800.00
A03184	3		X	C	.0200	5.3004	8.89	-13.33	800.00
A03184	4		X	C	.0330	.1691	26.03	4.44	800.00
A03184	5		X	C	.0330	6.2110	26.35	-1.90	800.00
A03184	6		X	C	.0339	5.8352	24.45	-11.75	800.00
A03184	7		X	C	.0348	.2533	26.99	6.98	800.00
A03184	8		X	C	.0349	6.1349	27.62	-4.13	800.00
A03184	9		X	C	.0286	5.7761	20.00	-11.11	800.00
A03184	10		X	C	.0275	.4959	19.37	10.48	800.00
A03184	11		X	C	.0295	6.1889	23.49	-2.22	800.00
A03184	12		X	C	.0276	5.9160	20.64	-7.94	800.00
A03184	13		X	C	.0246	.1784	19.37	3.49	800.00
A03184	14		X	C	.0239	.0997	19.05	1.90	800.00
A03184	15		X	C	.0244	6.1689	19.37	-2.22	800.00
A03184	16		X	C	.0393	.0404	31.43	1.27	800.00
A03184	17		X	C	.0382	.0831	30.48	2.54	800.00
A03184	18		X	C	.0353	.0225	28.26	.63	800.00
A03184	19		X	C	.0253	.8520	13.33	15.24	800.00
A03184	20		X	C	.0108	.4145	7.94	3.49	800.00
A03184	21		X	C	.0335	5.4056	17.14	-20.64	800.00
A03184	22		X	C	.0315	.2419	24.45	6.03	800.00
A03184	23		X	C	.0267	.0745	21.27	1.59	800.00
A03184	24		X	C	.0304	5.9780	23.18	-7.30	800.00
A03184	25		X	C	.0305	.4869	21.59	11.43	800.00
A03184	26		X	C	.0286	.0278	22.86	.63	800.00
A03184	27		X	C	.0262	5.8942	19.37	-7.94	800.00
A03184	28		X	C	.0262	.5586	17.78	11.11	800.00
A03184	29		X	C	.0255	.0780	20.32	1.59	800.00
A03184	30		X	C	.0319	6.0955	25.08	-4.76	800.00
A03184	31		X	C	.0346	.1727	27.30	4.76	800.00
A03184	32		X	C	.0306	.0260	24.45	.63	800.00
A03184	33		X	C	.0294	6.1203	23.18	-3.81	800.00
A03184	34		X	C	.0375	.1060	29.84	3.17	800.00
A03184	35		X	C	.0363	.0936	28.89	2.86	800.00
A03184	36		X	C	.0546	6.0858	42.86	-8.57	800.00
A03185	1			C	.0384	.1974	30.16	6.03	800.00
A03185	2			C	.0243	.0659	19.37	1.27	800.00
A03185	3			C	.0390	6.1298	30.80	-4.76	800.00
A03185	4			C	.0402	.0593	32.07	1.90	800.00
A03185	5			C	.0371	6.1761	29.53	-3.17	800.00
A03185	6			C	.0364	6.0858	28.57	-5.71	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03185	7			C	.0346	.0689	27.62	1.90	800.00
A03185	8			C	.0433	6.2557	34.61	-.95	800.00
A03185	9			C	.0373	5.9581	28.26	-9.52	800.00
A03185	10			C	.0455	.1135	36.19	4.13	800.00
A03185	11			C	.0394	6.2227	31.43	-1.90	800.00
A03185	12			C	.0417	6.0821	32.70	-6.67	800.00
A03185	13			C	.0385	6.2729	30.80	-.32	800.00
A03185	14			C	.0381	6.2624	30.48	-.63	800.00
A03185	15			C	.0414	6.1969	33.02	-2.86	800.00
A03185	16			C	.0449	6.2213	35.88	-2.22	800.00
A03185	17			C	.0643	.0123	51.43	.63	800.00
A03185	18			C	.0518	6.0903	40.64	-7.94	800.00
A03185	19			C	.0349	.3002	26.67	8.25	800.00
A03185	20			C	.0278	.0143	22.22	.32	800.00
A03185	21			C	.0382	5.4831	21.27	-21.91	800.00
A03185	22			C	.0449	6.2566	35.88	-.95	800.00
A03185	23			C	.0403	6.1051	31.75	-5.71	800.00
A03185	24			C	.0391	5.9197	29.21	-11.11	800.00
A03185	25			C	.0397	.0300	31.75	.95	800.00
A03185	26			C	.0420	6.1600	33.34	-4.13	800.00
A03185	27			C	.0435	5.9095	32.38	-12.70	800.00
A03185	28			C	.0428	6.1531	33.97	-4.44	800.00
A03185	29			C	.0354	6.2047	28.26	-2.22	800.00
A03185	30			C	.0395	5.9773	30.16	-9.52	800.00
A03185	31			C	.0275	6.1821	21.91	-2.22	800.00
A03185	32			C	.0341	.0233	27.30	.63	800.00
A03185	33			C	.0358	5.9790	27.30	-8.57	800.00
A03185	34			C	.0706	.0112	56.51	.63	800.00
A03185	35			C	.0617	6.2059	49.21	-3.81	800.00
A03185	36			C	.0764	6.1633	60.64	-7.30	800.00
A03185	1		X	C	.0433	.1471	34.29	5.08	800.00
A03185	2		X	C	.0302	.0263	24.13	.63	800.00
A03185	3		X	C	.0390	6.1298	30.80	-4.76	800.00
A03185	4		X	C	.0329	.1453	26.03	3.81	800.00
A03185	5		X	C	.0417	6.2546	33.34	-.95	800.00
A03185	6		X	C	.0370	5.9445	27.94	-9.84	800.00
A03185	7		X	C	.0367	.0975	29.21	2.86	800.00
A03185	8		X	C	.0449	.0530	35.88	1.90	800.00
A03185	9		X	C	.0332	6.1633	26.35	-3.17	800.00
A03185	10		X	C	.0445	.0179	35.56	.63	800.00
A03185	11		X	C	.0322	6.2585	25.72	-.63	800.00
A03185	12		X	C	.0321	5.9692	24.45	-7.94	800.00
A03185	13		X	C	.0371	.1071	29.53	3.17	800.00
A03185	14		X	C	.0325	6.2710	26.03	-.32	800.00
A03185	15		X	C	.0331	6.1990	26.35	-2.22	800.00
A03185	16		X	C	.0418	.0655	33.34	2.86	800.00
A03185	17		X	C	.0556	.0214	44.45	.95	800.00
A03185	18		X	C	.0520	.0305	41.59	1.27	800.00
A03185	19		X	C	.0337	.0235	26.99	.63	800.00
A03185	20		X	C	.0245	.2292	19.05	4.44	800.00
A03185	21		X	C	.0455	5.5348	26.67	-24.76	800.00
A03185	22		X	C	.0437	.1457	34.61	5.08	800.00
A03185	23		X	C	.0377	.0000	30.16	.00	800.00
A03185	24		X	C	.0331	5.9539	25.08	-8.57	800.00
A03185	25		X	C	.0367	.1740	28.89	5.08	800.00
A03185	26		X	C	.0299	6.0962	23.49	-4.44	800.00
A03185	27		X	C	.0366	6.1198	28.89	-4.76	800.00
A03185	28		X	C	.0362	6.2064	28.89	-2.22	800.00
A03185	29		X	C	.0267	6.0887	20.95	-4.13	800.00
A03185	30		X	C	.0331	6.0411	25.72	-6.35	800.00
A03185	31		X	C	.0214	.0000	17.14	.00	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03185	32		X	C	.0341	.0233	27.30	.63	800.00
A03185	33		X	C	.0400	6.0430	31.11	-7.62	800.00
A03185	34		X	C	.0714	.0111	57.15	.63	800.00
A03185	35		X	C	.0641	6.1964	51.12	-4.44	800.00
A03185	36		X	C	.0766	6.1061	60.32	-10.79	800.00
A03186	1	A		H	.0092	1.4411	.95	7.30	800.00
A03186	2	A		H	.0060	.4049	4.44	1.90	800.00
A03186	3	A		H	.0177	5.4819	9.84	-10.16	800.00
A03186	4	A		H	.0259	.1073	20.64	2.22	800.00
A03186	5	A		H	.0229	.1566	18.10	2.86	800.00
A03186	6	A		H	.0259	5.4110	13.33	-15.87	800.00
A03186	7	A		H	.0215	.5880	14.29	9.52	800.00
A03186	8	A		H	.0153	5.9123	11.43	-4.44	800.00
A03186	9	A		H	.0287	5.7143	19.37	-12.38	800.00
A03186	10	A		H	.0223	.2148	17.46	3.81	800.00
A03186	11	A		H	.0171	.0000	13.65	.00	600.00
A03186	12	A		H	.0270	5.9382	20.32	-7.30	800.00
A03186	13	A		H	.0245	.3474	18.41	6.67	800.00
A03186	14	A		H	.0095	6.2415	7.62	-.32	800.00
A03186	15	A		H	.0322	5.8637	23.49	-10.48	800.00
A03186	16	A		H	.0457	.3272	34.61	11.75	800.00
A03186	17	A		H	.0271	6.1806	21.59	-2.22	800.00
A03186	18	A		H	.0171	.3805	12.70	5.08	800.00
A03186	19	A		H	.0254	.5056	17.78	9.84	800.00
A03186	20	A		H	.0174	5.9830	13.33	-4.13	800.00
A03186	21	A		H	.0249	5.1403	8.25	-18.10	800.00
A03186	22	A		H	.0274	.2485	21.27	5.40	800.00
A03186	23	A		H	.0287	6.0885	22.54	-4.44	800.00
A03186	24	A		H	.0287	5.6452	18.41	-13.65	800.00
A03186	25	A		H	.0245	.3985	18.10	7.62	800.00
A03186	26	A		H	.0210	6.0932	16.51	-3.17	800.00
A03186	27	A		H	.0165	5.7551	11.43	-6.67	800.00
A03186	28	A		H	.0289	.2216	22.54	5.08	800.00
A03186	29	A		H	.0202	5.9428	15.24	-5.40	800.00
A03186	30	A		H	.0149	5.9866	11.43	-3.49	800.00
A03186	31	A		H	.0174	.3002	13.33	4.13	800.00
A03186	32	A		H	.0082	5.6009	5.08	-4.13	800.00
A03186	33	A		H	.0220	5.9900	16.83	-5.08	800.00
A03186	34	A		H	.0262	6.2529	20.95	-.63	800.00
A03186	35	A		H	.0251	6.1882	20.00	-1.90	800.00
A03186	36	A		H	.0202	.0000	16.19	.00	800.00
A03186	1	B		H	.0152	.2640	11.75	3.17	800.00
A03186	2	B		H	.0111	.0713	8.89	.63	800.00
A03186	3	B		H	.0160	6.0322	12.38	-3.17	800.00
A03186	4	B		H	.0289	.5499	19.68	12.06	800.00
A03186	5	B		H	.0314	6.2200	25.08	-1.59	800.00
A03186	6	B		H	.0290	6.2421	23.18	-.95	800.00
A03186	7	B		H	.0278	.8359	14.92	16.51	800.00
A03186	8	B		H	.0208	6.1683	16.51	-1.90	800.00
A03186	9	B		H	.0222	5.7796	15.56	-8.57	800.00
A03186	10	B		H	.0333	.6841	20.64	16.83	800.00
A03186	11	B		H	.0253	.2374	19.68	4.76	800.00
A03186	12	B		H	.0228	5.7338	15.56	-9.52	800.00
A03186	13	B		H	.0311	.4922	21.91	11.75	800.00
A03186	14	B		H	.0189	.2552	14.60	3.81	800.00
A03186	15	B		H	.0205	6.1276	16.19	-2.54	800.00
A03186	16	B		H	.0432	.2316	33.65	7.94	800.00
A03186	17	B		H	.0409	6.2444	32.70	-1.27	800.00
A03186	18	B		H	.0338	.0470	26.99	1.27	800.00
A03186	19	B		H	.0259	1.2588	6.35	19.68	800.00
A03186	20	B		H	.0107	.5468	7.30	4.44	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03186	21	B		H	.0126	5.9614	9.52	-3.17	800.00
A03186	22	B		H	.0237	.5462	16.19	9.84	800.00
A03186	23	B		H	.0242	6.2340	19.37	-.95	800.00
A03186	24	B		H	.0203	.0783	16.19	1.27	800.00
A03186	25	B		H	.0231	.3869	17.14	6.98	800.00
A03186	26	B		H	.0183	.0867	14.60	1.27	800.00
A03186	27	B		H	.0276	6.1535	21.91	-2.86	800.00
A03186	28	B		H	.0230	.3163	17.46	5.71	800.00
A03186	29	B		H	.0247	6.1867	19.68	-1.90	800.00
A03186	30	B		H	.0257	.2337	20.00	4.76	800.00
A03186	31	B		H	.0245	.2292	19.05	4.44	800.00
A03186	32	B		H	.0229	6.1266	18.10	-2.86	800.00
A03186	33	B		H	.0246	5.9206	18.41	-6.98	800.00
A03186	34	B		H	.0344	.1158	27.30	3.17	800.00
A03186	35	B		H	.0406	6.1261	32.07	-5.08	800.00
A03186	36	B		H	.0401	6.2634	32.07	-.63	800.00
A03186	1	C		H	.0126	6.0611	9.84	-2.22	800.00
A03186	2	C		H	.0101	5.5533	6.03	-5.40	800.00
A03186	3	C		H	.0109	4.8955	1.59	-8.57	800.00
A03186	4	C		H	.0211	.2661	16.19	4.76	800.00
A03186	5	C		H	.0203	6.2440	16.19	-.63	800.00
A03186	6	C		H	.0238	5.7972	16.83	-6.89	800.00
A03186	7	C		H	.0214	6.2647	17.14	-.32	800.00
A03186	8	C		H	.0163	6.2588	13.02	-.32	800.00
A03186	9	C		H	.0242	5.6725	15.87	-11.11	800.00
A03186	10	C		H	.0172	.3290	13.02	4.44	800.00
A03186	11	C		H	.0234	6.2493	18.73	-.63	800.00
A03186	12	C		H	.0265	5.9472	20.00	-6.98	800.00
A03186	13	C		H	.0234	6.2324	18.73	-.95	800.00
A03186	14	C		H	.0187	.0637	14.92	.95	800.00
A03186	15	C		H	.0189	5.7068	12.70	-8.25	800.00
A03186	16	C		H	.0472	.0168	37.78	.63	800.00
A03186	17	C		H	.0385	.0103	30.80	.32	800.00
A03186	18	C		H	.0362	6.2393	28.89	-1.27	800.00
A03186	19	C		H	.0181	.2663	13.97	3.81	800.00
A03186	20	C		H	.0250	.0159	20.00	.32	800.00
A03186	21	C		H	.0157	4.9942	3.49	-12.06	800.00
A03186	22	C		H	.0284	.3129	21.59	6.98	800.00
A03186	23	C		H	.0201	6.0239	15.56	-4.13	800.00
A03186	24	C		H	.0284	5.7883	20.00	-10.79	800.00
A03186	25	C		H	.0210	.6511	13.33	10.16	800.00
A03186	26	C		H	.0159	.0500	12.70	.63	800.00
A03186	27	C		H	.0318	5.9259	23.81	-8.89	800.00
A03186	28	C		H	.0287	.5688	19.37	12.38	800.00
A03186	29	C		H	.0199	6.2034	15.87	-1.27	800.00
A03186	30	C		H	.0211	5.9376	15.87	-5.71	800.00
A03186	31	C		H	.0254	.4357	18.41	8.57	800.00
A03186	32	C		H	.0119	6.2166	9.52	-.63	800.00
A03186	33	C		H	.0232	6.1631	18.41	-2.22	800.00
A03186	34	C		H	.0413	.1446	32.70	4.76	800.00
A03186	35	C		H	.0308	.1164	24.45	2.86	800.00
A03186	36	C		H	.0522	6.1994	41.59	-3.49	800.00
A03187	1	A		C	.0149	1.1310	5.08	10.79	800.00
A03187	2	A		C	.0069	6.1085	5.40	-.95	800.00
A03187	3	A		C	.0107	5.9027	7.94	-3.17	800.00
A03187	4	A		C	.0312	.3781	23.18	9.21	800.00
A03187	5	A		C	.0311	.1022	24.76	2.54	800.00
A03187	6	A		C	.0306	5.9532	23.18	-7.94	800.00
A03187	7	A		C	.0301	.3928	22.22	9.21	800.00
A03187	8	A		C	.0235	6.1986	18.73	-1.59	800.00
A03187	9	A		C	.0197	5.9551	14.92	-5.08	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	ϕ	X	Y	RANGE
A03187	10	A		C	.0297	.3260	22.54	7.62	800.00
A03187	11	A		C	.0278	.0571	22.22	1.27	800.00
A03187	12	A		C	.0272	5.9568	20.64	-6.98	800.00
A03187	13	A		C	.0210	.3277	15.87	5.40	800.00
A03187	14	A		C	.0178	.2018	13.97	2.86	800.00
A03187	15	A		C	.0224	6.0511	17.46	-4.13	800.00
A03187	16	A		C	.0388	.1853	30.48	5.71	800.00
A03187	17	A		C	.0394	.0806	31.43	2.54	800.00
A03187	18	A		C	.0523	6.1155	41.27	-6.98	800.00
A03187	19	A		C	.0210	.9197	10.16	13.33	800.00
A03187	20	A		C	.0204	.2355	15.87	3.81	800.00
A03187	21	A		C	.0211	5.5644	12.70	-11.11	800.00
A03187	22	A		C	.0302	.5224	20.95	12.06	800.00
A03187	23	A		C	.0236	.1181	18.73	2.22	800.00
A03187	24	A		C	.0344	5.7368	23.49	-14.29	800.00
A03187	25	A		C	.0239	.7736	13.65	13.33	800.00
A03187	26	A		C	.0204	.1364	16.19	2.22	800.00
A03187	27	A		C	.0267	5.8861	19.68	-8.25	800.00
A03187	28	A		C	.0256	.5191	17.78	10.16	800.00
A03187	29	A		C	.0203	.0392	16.19	.63	800.00
A03187	30	A		C	.0275	5.9295	20.64	-7.62	800.00
A03187	31	A		C	.0286	.3393	21.59	7.62	800.00
A03187	32	A		C	.0218	.0363	17.46	.63	800.00
A03187	33	A		C	.0264	5.8330	19.05	-9.21	800.00
A03187	34	A		C	.0345	.3036	26.35	8.25	800.00
A03187	35	A		C	.0272	.1171	21.59	2.54	800.00
A03187	36	A		C	.0279	5.9795	21.27	-6.67	800.00
A03187	1	B		C	.0186	.6947	11.43	9.52	800.00
A03187	2	B		C	.0147	.0540	11.75	.63	800.00
A03187	3	B		C	.0167	5.9690	12.70	-4.13	800.00
A03187	4	B		C	.0336	.1185	26.67	3.17	800.00
A03187	5	B		C	.0271	6.1806	21.59	-2.22	800.00
A03187	6	B		C	.0241	5.9823	18.41	-5.71	800.00
A03187	7	B		C	.0302	.0000	24.13	.00	800.00
A03187	8	B		C	.0268	6.0130	20.64	-5.71	800.00
A03187	9	B		C	.0283	6.1849	22.54	-2.22	800.00
A03187	10	B		C	.0302	.1716	23.81	4.13	800.00
A03187	11	B		C	.0286	5.9877	21.91	-6.67	800.00
A03187	12	B		C	.0211	6.0747	16.51	-3.49	800.00
A03187	13	B		C	.0300	.3092	22.86	7.30	800.00
A03187	14	B		C	.0215	.0595	17.14	.95	800.00
A03187	15	B		C	.0202	6.0049	15.56	-4.44	800.00
A03187	16	B		C	.0365	.1419	28.89	4.13	800.00
A03187	17	B		C	.0309	6.0631	24.13	-5.40	800.00
A03187	18	B		C	.0441	6.2472	35.24	-1.27	800.00
A03187	19	B		C	.0084	1.4289	.95	6.67	800.00
A03187	20	B		C	.0110	.4475	7.94	3.81	800.00
A03187	21	B		C	.0210	5.3635	10.16	-13.33	800.00
A03187	22	B		C	.0297	.1476	23.49	3.49	800.00
A03187	23	B		C	.0230	6.2315	18.41	-.95	800.00
A03187	24	B		C	.0292	6.0778	22.86	-4.76	800.00
A03187	25	B		C	.0304	.2640	23.49	6.35	800.00
A03187	26	B		C	.0278	.0000	22.22	.00	800.00
A03187	27	B		C	.0281	5.9971	21.59	-6.35	800.00
A03187	28	B		C	.0275	.2625	21.27	5.71	800.00
A03187	29	B		C	.0298	6.2299	23.81	-1.27	800.00
A03187	30	B		C	.0331	6.1752	26.35	-2.86	800.00
A03187	31	B		C	.0280	.2141	21.91	4.76	800.00
A03187	32	B		C	.0323	.0984	25.72	2.54	800.00
A03187	33	B		C	.0318	6.0564	24.76	-5.71	800.00
A03187	34	B		C	.0444	.1886	34.92	6.67	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	ϕ	X	Y	RANGE
A03187	35	B		C	.0382	.2198	29.84	6.67	800.00
A03187	36	B		C	.0434	.0915	34.61	3.17	800.00
A03187	1	C		C	.0275	.4314	20.00	9.21	800.00
A03187	2	C		C	.0120	1.6705	-.95	9.52	800.00
A03187	3	C		C	.0174	5.0126	4.13	-13.33	800.00
A03187	4	C		C	.0371	.3726	27.62	10.79	800.00
A03187	5	C		C	.0268	.2090	20.95	4.44	800.00
A03187	6	C		C	.0355	6.0003	27.30	-7.94	800.00
A03187	7	C		C	.0300	.[illegible]814	21.27	11.11	800.00
A03187	8	C		C	.0230	.0345	18.41	.63	800.00
A03187	9	C		C	.0254	5.8475	18.41	-8.57	800.00
A03187	10	C		C	.0263	.4366	19.05	8.89	800.00
A03187	11	C		C	.0254	6.2519	20.32	-.63	800.00
A03187	12	C		C	.0288	5.7949	20.32	-10.79	800.00
A03187	13	C		C	.0309	.5096	21.59	12.06	800.00
A03187	14	C		C	.0270	6.2538	21.59	-.63	800.00
A03187	15	C		C	.0245	6.0382	19.05	-4.76	800.00
A03187	16	C		C	.0466	.3568	34.92	13.02	800.00
A03187	17	C		C	.0311	.3379	23.49	8.25	800.00
A03187	18	C		C	.0377	6.2411	30.16	-1.27	800.00
A03187	19	C		C	.0186	.8459	9.84	11.11	800.00
A03187	20	C		C	.0414	6.1291	32.70	-5.08	800.00
A03187	21	C		C	.0318	5.8028	22.54	-11.75	800.00
A03187	22	C		C	.0504	.0315	40.32	1.27	800.00
A03187	23	C		C	.0366	.0651	29.21	1.90	800.00
A03187	24	C		C	.0432	5.8771	31.75	-13.65	800.00
A03187	25	C		C	.0279	.3937	20.64	8.57	800.00
A03187	26	C		C	.0298	.0167	23.81	.63	800.00
A03187	27	C		C	.0346	5.8452	25.08	-11.75	800.00
A03187	28	C		C	.0323	.3256	24.45	8.25	800.00
A03187	29	C		C	.0369	6.1350	21.27	-3.17	800.00
A03187	30	C		C	.0343	6.1314	26.99	-4.13	800.00
A03187	31	C		C	.0241	.2330	18.73	4.44	800.00
A03187	32	C		C	.0223	6.2119	17.78	-1.27	800.00
A03187	33	C		C	.0317	6.0686	24.76	-5.40	800.00
A03187	34	C		C	.0312	.1275	24.76	3.17	800.00
A03187	35	C		C	.0310	.0128	24.76	.32	800.00
A03187	36	C		C	.0372	6.1869	29.59	-2.86	800.00
A03187	1	A	X	C	.0163	.7165	9.84	8.57	800.00
A03187	2	A	X	C	.0067	.0000	5.40	.00	800.00
A03187	3	A	X	C	.0123	5.4978	6.98	-6.98	800.00
A03187	4	A	X	C	.0349	.2643	26.99	7.30	800.00
A03187	5	A	X	C	.0286	6.2139	22.86	-1.59	800.00
A03187	6	A	X	C	.0355	.1008	28.75	2.86	800.00
A03187	7	A	X	C	.0250	.4424	18.10	8.57	800.00
A03187	8	A	X	C	.0215	6.2092	17.14	-1.27	800.00
A03187	9	A	X	C	.0237	5.8871	17.46	-7.30	800.00
A03187	10	A	X	C	.0307	.4405	22.22	10.48	800.00
A03187	11	A	X	C	.0275	.1889	21.59	4.13	800.00
A03187	12	A	X	C	.0307	6.1010	24.13	-4.44	800.00
A03187	13	A	X	C	.0201	.4283	14.60	6.67	800.00
A03187	14	A	X	C	.0161	6.1099	12.70	-2.22	800.00
A03187	15	A	X	C	.0238	5.8345	17.14	-6.25	800.00
A03187	16	A	X	C	.0387	.1129	30.80	3.49	800.00
A03187	17	A	X	C	.0409	.0194	32.70	.63	800.00
A03187	18	A	X	C	.0504	6.0287	39.05	-10.16	800.00
A03187	19	A	X	C	.0188	.7407	11.11	10.16	800.00
A03187	20	A	X	C	.0118	.3430	8.89	3.17	800.00
A03187	21	A	X	C	.0165	5.3271	7.62	-10.79	800.00
A03187	22	A	X	C	.0302	.4636	21.59	10.79	800.00
A03187	23	A	X	C	.0228	6.1610	18.10	-2.22	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	ϕ	X	Y	RANGE
A03187	24	A	X	C	.0369	5.6504	23.81	-17.46	800.00
A03187	25	A	X	C	.0218	.5779	14.60	9.52	800.00
A03187	26	A	X	C	.0179	6.0597	13.97	-3.17	800.00
A03187	27	A	X	C	.0270	5.6544	17.46	-12.70	800.00
A03187	28	A	X	C	.0295	.4757	20.95	10.79	800.00
A03187	29	A	X	C	.0230	6.2487	18.41	-.63	800.00
A03187	30	A	X	C	.0323	5.6815	21.27	-14.60	800.00
A03187	31	A	X	C	.0204	.4636	14.60	7.30	800.00
A03187	32	A	X	C	.0224	6.1764	17.78	-1.90	800.00
A03187	33	A	X	C	.0217	5.6800	14.29	-9.84	800.00
A03187	34	A	X	C	.0381	.1463	30.16	4.44	800.00
A03187	35	A	X	C	.0314	.0758	25.08	1.90	800.00
A03187	36	A	X	C	.0315	5.9893	24.13	-7.30	800.00
A03187	1	B	X	C	.0166	.5814	11.11	7.30	800.00
A03187	2	B	X	C	.0128	6.0006	9.84	-2.86	800.00
A03187	3	B	X	C	.0117	5.9722	8.89	-2.86	800.00
A03187	4	B	X	C	.0282	.2416	21.91	5.40	800.00
A03187	5	B	X	C	.0294	.2876	22.54	6.67	800.00
A03187	6	B	X	C	.0305	6.1266	24.13	-3.81	800.00
A03187	7	B	X	C	.0258	.0154	20.64	.32	800.00
A03187	8	B	X	C	.0218	6.2650	17.46	-.32	800.00
A03187	9	B	X	C	.0264	5.9614	20.00	-6.67	800.00
A03187	10	B	X	C	.0222	.3274	16.83	5.71	800.00
A03187	11	B	X	C	.0222	.0000	17.78	.00	800.00
A03187	12	B	X	C	.0206	6.2640	16.51	-.32	800.00
A03187	13	B	X	C	.0163	.4528	11.75	5.71	800.00
A03187	14	B	X	C	.0193	6.0332	14.92	-3.81	800.00
A03187	15	B	X	C	.0237	6.1152	18.73	-3.17	800.00
A03187	16	B	X	C	.0249	.1124	19.68	2.22	800.00
A03187	17	B	X	C	.0274	6.2687	21.91	-.32	800.00
A03187	18	B	X	C	.0358	6.1272	28.26	-4.44	800.00
A03187	19	B	X	C	.0123	2.1499	-5.40	8.25	800.00
A03187	20	B	X	C	.0157	.7854	8.89	8.89	800.00
A03187	21	B	X	C	.0162	5.0863	4.76	-12.06	800.00
A03187	22	B	X	C	.0286	.2954	21.91	6.67	800.00
A03187	23	B	X	C	.0262	6.2378	20.95	-.95	800.00
A03187	24	B	X	C	.0218	6.0749	16.83	-4.44	800.00
A03187	25	B	X	C	.0280	.3173	21.27	6.98	800.00
A03187	26	B	X	C	.0248	6.1708	19.68	-2.22	800.00
A03187	27	B	X	C	.0269	6.0597	20.95	-4.76	800.00
A03187	28	B	X	C	.0332	.3672	24.76	9.52	800.00
A03187	29	B	X	C	.0215	6.1909	17.14	-1.59	800.00
A03187	30	B	X	C	.0248	6.0732	19.37	-4.13	800.00
A03187	31	B	X	C	.0305	.2765	23.49	6.67	800.00
A03187	32	B	X	C	.0261	6.1305	20.64	-3.17	800.00
A03187	33	B	X	C	.0253	6.1413	20.00	-2.86	800.00
A03187	34	B	X	C	.0455	.2831	34.92	10.16	800.00
A03187	35	B	X	C	.0294	.1762	23.18	4.13	800.00
A03187	36	B	X	C	.0376	6.1667	29.84	-3.49	800.00
A03187	1	C	X	C	.0220	.2362	17.14	4.13	800.00
A03187	2	C	X	C	.0061	1.7682	-.95	4.76	800.00
A03187	3	C	X	C	.0151	4.9510	2.86	-11.75	800.00
A03187	4	C	X	C	.0332	.1927	26.03	5.08	800.00
A03187	5	C	X	C	.0294	.2876	22.54	6.67	800.00
A03187	6	C	X	C	.0374	5.9480	28.26	-9.84	800.00
A03187	7	C	X	C	.0296	.3556	22.22	8.25	800.00
A03187	8	C	X	C	.0193	.1651	15.24	2.54	800.00
A03187	9	C	X	C	.0305	5.7204	20.64	-13.02	800.00
A03187	10	C	X	C	.0282	.3753	20.95	8.25	800.00
A03187	11	C	X	C	.0252	.2221	19.68	4.44	800.00
A03187	12	C	X	C	.0333	5.9049	24.76	-9.84	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03187	13	C	X	C	.0300	.2674	23.18	6.35	800.00
A03187	14	C	X	C	.0314	6.2579	25.08	-.63	800.00
A03187	15	C	X	C	.0220	5.9900	16.83	-5.08	800.00
A03187	16	C	X	C	.0457	.5374	31.43	18.73	800.00
A03187	17	C	X	C	.0315	.4016	23.18	9.84	800.00
A03187	18	C	X	C	.0370	6.1216	29.21	-4.76	800.00
A03187	19	C	X	C	.0263	1.1342	8.89	19.05	800.00
A03187	20	C	X	C	.0291	5.9787	22.22	-6.98	800.00
A03187	21	C	X	C	.0310	5.8884	22.86	-9.52	800.00
A03187	22	C	X	C	.0500	.1194	39.69	4.76	800.00
A03187	23	C	X	C	.0274	.0145	21.91	.32	800.00
A03187	24	C	X	C	.0348	5.8093	24.76	-12.70	800.00
A03187	25	C	X	C	.0236	.3430	17.78	6.35	800.00
A03187	26	C	X	C	.0191	6.2208	15.24	-.95	800.00
A03187	27	C	X	C	.0250	5.5539	14.92	-13.33	800.00
A03187	28	C	X	C	.0247	.4852	17.46	9.21	800.00
A03187	29	C	X	C	.0239	.2007	18.73	3.81	800.00
A03187	30	C	X	C	.0345	5.8613	25.40	-10.79	800.00
A03187	31	C	X	C	.0196	.2450	15.24	3.81	800.00
A03187	32	C	X	C	.0262	.0000	20.95	.00	800.00
A03187	33	C	X	C	.0224	5.8037	15.87	-8.25	800.00
A03187	34	C	X	C	.0302	.0263	24.13	.63	800.00
A03187	35	C	X	C	.0316	.2023	24.76	5.08	800.00
A03187	36	C	X	C	.0198	6.1015	15.56	-2.86	800.00
A03189	1			A	.0062	2.4469	-3.81	3.17	800.00
A03189	2			A	.0060	3.0750	-4.76	.32	800.00
A03189	3			A	.0048	3.1416	-3.81	.00	800.00
A03189	4			A	.0044	3.0509	-3.49	.32	800.00
A03189	5			A	.0045	2.8753	-3.49	.95	800.00
A03189	6			A	.0037	2.9229	-2.86	.63	800.00
A03189	7			A	.0039	2.7234	-2.86	1.27	800.00
A03189	8			A	.0025	2.8198	-1.90	.63	800.00
A03189	9			A	.0029	2.5536	-1.90	1.27	800.00
A03189	10			A	.0040	2.2143	-1.90	2.54	800.00
A03189	11			A	.0042	2.2896	-2.22	2.54	800.00
A03189	12			A	.0043	2.1588	-1.90	2.86	800.00
A03189	13			A	.0046	1.9196	-1.27	3.49	800.00
A03189	14			A	.0029	2.1588	-1.27	1.90	800.00
A03189	15			A	.0022	2.3562	-1.27	1.27	800.00
A03189	16			A	.0016	3.1416	-1.27	.00	800.00
A03189	17			A	.0009	2.6779	-.63	.32	800.00
A03189	18			A	.0029	1.8491	-.63	2.22	800.00
A03189	19			A	.0036	1.6815	-.32	2.86	800.00
A03189	20			A	.0016	1.8158	-.32	1.27	800.00
A03189	21			A	.0040	1.4711	.32	3.17	800.00
A03189	22			A	.0012	1.5708	.00	.95	800.00
A03189	23			A	.0004	.0000	.32	.00	800.00
A03189	24			A	.0016	1.3258	.32	1.27	800.00
A03189	25			A	.0020	1.3734	.32	1.59	800.00
A03189	26			A	.0053	1.3440	.95	4.13	800.00
A03189	27			A	.0036	.1107	2.86	.32	800.00
A03189	28			A	.0025	.6747	1.59	1.27	800.00
A03189	29			A	.0044	[illegible]	3.17	1.59	800.00
A03189	30			A	.0050	.4993	3.49	1.90	800.00
A03189	31			A	.0085	.6529	[illegible]	4.13	800.00
A03189	32			A	[illegible]	.1651	5.71	.95	800.00
A03189	33			A	.0089	.1799	6.98	1.27	800.00
A03189	34			A	.0098	.1244	7.62	.95	800.00
A03189	35			A	.0008	3.1416	-.63	.00	800.00
A03189	36			A	.0016	3.3866	-1.27	-.32	800.00
A03189	37			A	.0024	3.1416	-1.90	.00	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG		X	Y RANGE
A03189	38			A	.00323.2659	-2.54	-.32800.00
A03189	39			A	.00403.2413	-3.17	-.32800.00
A03189	40			A	.00094.2487	-.32	-.63800.00
A03189	41			A	.00133.4633	-.95	-.32800.00
A03189	42			A	.00163.6052	-1.27	-.63800.00
A03189	43			A	.00[illegible]3.4633	-1.90	-.63800.00
A03189	44			A	.00303.5465	-2.22	-.95800.00
A03189	45			A	.00254.0378	-1.27	-1.59800.00
A03189	46			A	.00253.8163	-1.59	-1.27800.00
A03189	47			A	.00323.6607	-2.22	-1.27800.00
A03189	48			A	.00343.7618	-2.22	-1.59800.00
A03189	49			A	.00413.6487	-2.86	-1.59800.00
A03189	50			A	.00553.6697	-3.81	-2.22800.00
A03189	51			A	.00483.9682	-2.86	-2.54800.00
A03189	52			A	.00454.0513	-2.22	-2.86800.00
A03189	53			A	.00394.2942	-1.27	-2.86800.00
A03189	54			A	.00533.8744	-3.17	-2.86800.00
A03189	55			A	.00563.8273	-3.49	-2.86800.00
A03189	56			A	.00853.5221	-6.35	-2.54800.00
A03189	57			A	.01143.7296	-7.62	-5.08800.00
A03189	58			A	.00694.1770	-2.86	-4.76800.00
A03189	59			A	.00714.2427	-2.54	-5.08800.00
A03189	60			A	.00944.2299	-3.49	-6.67800.00
A03189	61			A	.00804.5635	-.95	-6.35800.00
A03189	62			A	.00864.6127	-.63	-6.35800.00
A03189	63			A	.00634.7124	.00	-5.08800.00
A03189	64			A	.00754.7124	.00	-6.03800.00
A03189	65			A	.00604.9449	.63	-4.76800.00
A03189	66			A	.00444.3030	.32	-3.49800.00
A03189	67			A	.00294.8543	.32	-2.22800.00
A03189	68			A	.00204.9098	.32	-1.59800.00
A03189	69			A	.00135.0341	.32	-.95800.00
A03189	70			A	.00185.1760	.63	-1.27800.00
A03189	71			A	.00175.4978	.95	-.95800.00
A03189	72			A	.00395.1306	1.27	-2.86800.00
A03189	73			A	.00454.9786	.95	-3.49800.00
A03189	74			A	.00484.8775	.63	-3.81800.00
A03189	75			A	.00864.9461	1.59	-6.67800.00
A03189	76			A	.00955.0074	2.22	-7.30800.00
A03189	77			A	.00895.2757	3.81	-6.03800.00
A03189	78			A	.00685.5803	4.13	-3.49800.00
A03189	79			A	.00685.9244	5.08	-1.90800.00
A03189	80			A	.00845.1882	6.67	-.63800.00
A03190	1			A	.00872.2597	-4.44	5.40800.00
A03190	2			A	.00442.9617	-3.49	.63800.00
A03190	3			A	.00301.9757	-.95	2.22800.00
A03190	4			A	.00121.5706	.00	.95800.00
A03190	5			A	.00081.5708	.00	.63800.00
A03190	6			A	.00161.5708	.00	1.27800.00
A03190	7			A	.00241.4056	.32	1.90800.00
A03190	8			A	.00281.4299	.32	2.22800.00
A03190	9			A	.00201.3734	.32	1.59800.00
A03190	10			A	.00211.1903	.63	1.59800.00
A03190	11			A	.00181.1071	.63	1.27800.00
A03190	12			A	.0014 .9828	.63	.95800.00
A03190	13			A	.0016 .2450	1.27	.32800.00
A03190	14			A	.0017 .7854	.95	.95800.00
A03190	15			A	.0020 .9273	.95	1.27800.00
A03190	16			A	.00231.0304	.95	1.59800.00
A03190	17			A	.0034 .9505	1.59	2.22800.00
A03190	18			A	.00371.0127	1.59	2.54800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG		X	Y RANGE
A03190	19			A	.00761.4142	.95	6.03800.00
A03190	20			A	.01021.3353	1.90	7.94800.00
A03190	21			A	.00751.2490	1.90	5.71800.00
A03190	22			A	.0044 .9129	2.16	2.79800.00
A03190	23			A	.0035 .6889	2.16	1.78800.00
A03190	24			A	.0035 .4636	2.54	1.27800.00
A03190	25			A	.00371.1264	1.27	2.67800.00
A03190	26			A	.01051.1818	3.17	7.75800.00
A03190	27			A	.0055 .7650	3.17	3.05800.00
A03190	28			A	.0053 .6794	3.30	2.67800.00
A03190	29			A	.0043 .5469	2.92	1.78800.00
A03190	30			A	.0047 .1707	3.68	.63600.00
A03190	31			A	.0051 .5269	3.49	2.03800.00
A03190	32			A	.0054 .5555	3.68	2.29800.00
A03190	33			A	.0057 .6267	3.68	2.67800.00
A03190	34			A	.0108 .9214	5.21	6.86800.00
A03190	35			A	.0072 .1107	5.71	.63800.00
A03190	36			A	.0057 .0000	4.57	.00800.00
A03190	37			A	.00044.2487	-.13	-.25800.00
A03190	38			A	.00103.8163	-.63	-.51800.00
A03190	39			A	.00084.0689	-.38	-.51800.00
A03190	40			A	.00114.2487	-.38	-.76800.00
A03190	41			A	.00084.5150	-.13	-.63800.00
A03190	42			A	.00353.4846	-2.67	-.95800.00
A03190	43			A	.00313.9270	-1.78	-1.78800.00
A03190	44			A	.00284.5986	-.25	-2.22800.00
A03190	45			A	.00304.6598	-.13	-2.41800.00
A03190	46			A	.00334.6886	-.06	-2.67800.00
A03190	47			A	.00354.6670	-.13	-2.79800.00
A03190	48			A	.00394.5070	-.63	-3.05800.00
A03190	49			A	.00464.3255	-1.40	-3.43800.00
A03190	50			A	.00704.4263	-1.59	-5.40800.00
A03190	51			A	.00883.7671	-5.71	-4.13800.00
A03190	52			A	.0004 .0000	.32	.00800.00
A03190	53			A	.00136.0382	1.02	-.25800.00
A03190	54			A	.00145.6952	.95	-.63800.00
A03190	55			A	.00215.7165	1.40	-.89800.00
A03190	56			A	.00275.2023	1.02	-1.90800.00
A03190	57			A	.00364.8010	.25	-2.86800.0[illegible]
A03190	58			A	.00374.8421	.38	-2.92800 [illegible]
A03190	59			A	.00345.0929	1.02	-2.54800.00
A03190	60			A	.00355.8195	2.54	-1.27800.00
A03190	61			A	.00325.3756	1.59	-2.03800.00
A03190	62			A	.00414.9479	.76	-3.17800.00
A03190	63			A	.00435.0109	1.02	-3.30800.00
A03190	64			A	.00465.0993	1.40	-3.43800.00
A03190	65			A	.00405.4837	2.22	-2.29800.00
A03190	66			A	.00355.8195	2.54	-1.27800.00
A03190	67			A	.00355.9614	2.67	-.89800.00
A03190	68			A	.00376.1964	2.92	-.25800.00
A03190	69			A	.00545.1366	1.78	-3.94800.00
A03190	70			A	.00595.0680	1.65	-4.44800.00
A03190	71			A	.00275.6629	1.78	-1.27800.00
A03190	72			A	.00755.5482	4.83	-3.56800.00
A03190	73			A	.00875.7459	5.97	-3.56800.00
A03190	74			A	.00975.1323	3.17	-7.11800.00
A03190	75			A	.01024.9630	2.03	-7.57800.00
A03190	76			A	.01064.9245	1.78	-8.25800.00
A03190	77			A	.00914.8346	.89	-7.24800.00
A03190	78			A	.00844.8543	.95	-6.67800.00
A03190	79			A	.01284.8121	1.02	-10.16800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG		X	Y RANGE
A03190	80			A	.01174.7259	.13	-9.40800.00
A03191	1			A	.00722.0047	-2.41	5.21800.00
A03191	2			A	.00691.7547	-1.02	5.46800.00
A03191	3			A	.00591.5973	-.13	4.70800.00
A03191	4			A	.00622.2655	-3.17	3.21800.00
A03191	5			A	.00481.6374	-.25	3.81800.00
A03191	6			A	.00552.3358	-3.65	3.17800.00
A03191	7			A	.00351.7505	-.51	2.79800.00
A03191	8			A	.00351.6615	-.25	2.79800.00
A03191	9			A	.00482.6929	-3.43	1.65800.00
A03191	10			A	.00302.4669	-1.90	1.52800.00
A03191	11			A	.00212.1375	-.89	1.40800.00
A03191	12			A	.00151.7895	-.25	1.14800.00
A03191	13			A	.00373.0549	-2.92	.25800.00
A03191	14			A	.00383.1208	-3.05	.06800.00
A03191	15			A	.00481.5708	.00	3.81800.00
A03191	16			A	.00641.5498	.13	5.08800.00
A03191	17			A	.00741.4092	.95	5.84800.00
A03191	18			A	.00571.3597	.95	4.44800.00
A03191	19			A	.00341.3371	.63	2.67800.00
A03191	20			A	.00311.1526	1.02	2.29800.00
A03191	21			A	.0026 .8491	1.40	1.59800.00
A03191	22			A	.0032 .9076	1.59	2.03800.00
A03191	23			A	.00641.2530	1.59	4.83800.00
A03191	24			A	.00881.0830	3.30	6.22800.00
A03191	25			A	.0038 .7407	2.22	2.03800.00
A03191	26			A	.0023 .2111	1.78	.38800.00
A03191	27			A	.0020 .0000	1.59	.00800.00
A03191	28			A	.0034 .3367	2.54	.89800.00
A03191	29			A	.0041 .6747	2.54	2.03800.00
A03191	30			A	.0049 .6696	3.05	2.41800.00
A03191	31			A	.0052 .5457	3.56	2.16800.00
A03191	32			A	.0066 .4475	4.76	2.29800.00
A03191	33			A	.0082 .6202	5.33	3.81800.00
A03191	34			A	.0099 .6970	5.46	4.57800.00
A03191	35			A	.0108 .6916	6.73	5.46800.00
A03191	36			A	.0093 .3488	8.98	2.54800.00
A03191	37			A	.00543.2003	-4.32	-.25800.00
A03191	38			A	.00[illegible]33.2622	-4.19	-.51800.00
A03191	39			A	.00[illegible]33.4129	-2.29	-.63800.00
A03191	40			A	.00023.9270	-.13	-.13800.00
A03191	41			A	.00523.3718	-4.06	-.95800.00
A03191	42			A	.00633.6733	-4.32	-3.54800.00
A03191	43			A	.00383.9857	-2.03	-2.79800.00
A03191	44			A	.00324.5880	-.32	-2.54800.00
A03191	45			A	.00274.7125	.00	-2.16800.00
A03191	46			A	.00544.4461	-1.14	-4.19800.00
A03191	47			A	.00874.6760	-.25	-6.98800.00
A03191	48			A	.01074.2355	-3.94	-7.62800.00
A03191	49			A	.00045.4978	.25	-.25800.00
A03191	50			A	.00085.6397	.51	-.38800.00
A03191	51			A	.00115.1760	.38	-.76800.00
A03191	52			A	.00125.4071	.63	-.76800.00
A03191	53			A	.00195.2528	.76	-1.27800.00
A03191	54			A	.00324.8613	.38	-2.54800.00
A03191	55			A	.00245.1180	1.90	-.32800.00
A03191	56			A	.00326.2332	2.54	-.13800.00
A03191	57			A	.00516.2519	4.06	-.13800.00
A03191	58			A	.00305.3871	1.52	-1.90800.00
A03191	59			A	.00295.6952	1.90	-1.27800.00
A03191	60			A	.00325.9302	2.41	-.89800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	- φ	X	Y RANGE
A03191	61			A	.00355.8195	2.54	-1.27800.00
A03191	62			A	.00376.0226	2.86	-.76800.00
A03191	63			A	.00406.0858	3.17	-.63800.00
A03191	64			A	.00405.9614	3.05	-1.02800.00
A03191	65			A	.00565.9971	4.32	-1.27800.00
A03191	66			A	.00455.1919	1.65	-3.17800.00
A03191	67			A	.00565.7816	3.94	-2.16800.00
A03191	68			A	.00715.8195	5.08	-2.54800.00
A03191	69			A	.00825.7761	5.71	-3.17800.00
A03191	70			A	.00565.2528	2.29	-3.81800.00
A03191	71			A	.00704.7351	.13	-5.59800.00
A03191	72			A	.00635.0975	1.90	-4.70800.00
A03191	73			A	.00814.8905	1.14	-6.35800.00
A03191	74			A	.00765.0540	2.03	-5.71800.00
A03191	75			A	.00635.2528	3.43	-5.71800.00
A03191	76			A	.01095.4875	6.10	-6.22800.00
A03191	77			A	.00915.0896	2.67	-6.73800.00
A03191	78			A	.01084.9502	2.03	-8.38800.00
A03191	79			A	.01124.9402	2.03	-8.76800.00
A03191	80			A	.01224.7254	.13	-9.78800.00
A03192	1			A	.00441.5887	-.06	3.56800.00
A03192	2			A	.00401.7295	-.51	3.17800.00
A03192	3			A	.00321.6208	-.13	2.54800.00
A03192	4			A	.00211.6092	-.06	1.65800.00
A03192	5			A	.00092.1112	-.38	.63800.00
A03192	6			A	.00282.2368	-1.40	1.78800.00
A03192	7			A	.00252.0526	-.95	1.78800.00
A03192	8			A	.00221.9380	-.63	1.65800.00
A03192	9			A	.00202.3562	-1.14	1.14800.00
A03192	10			A	.00252.4669	-1.59	1.27800.00
A03192	11			A	.00252.4469	-1.52	1.27800.00
A03192	12			A	.00281.5708	.00	2.22800.00
A03192	13			A	.00241.5042	.13	1.90800.00
A03192	14			A	.00191.5292	.06	1.52800.00
A03192	15			A	.00181.3909	.25	1.40800.00
A03192	16			A	.0010 .8961	.51	.63800.00
A03192	17			A	.00141.1071	.51	1.02800.00
A03192	18			A	.00301.4400	.32	2.41800.00
A03192	19			A	.00351.4353	.38	2.79800.00
A03192	20			A	.00361.3949	.51	2.86800.00
A03192	21			A	.00361.3045	.76	2.79800.00
A03192	22			A	.00271.2679	.63	2.03800.00
A03192	23			A	.00171.0304	.76	1.27800.00
A03192	24			A	.0013 .2450	1.02	.25800.00
A03192	25			A	.0015 .2187	1.14	.25800.00
A03192	26			A	.0019 .6947	1.14	.95800.00
A03192	27			A	.00241.0015	1.02	1.59800.00
A03192	28			A	.00261.1342	.89	1.90800.00
A03192	29			A	.00281.0304	1.14	1.90800.00
A03192	30			A	.00281.1584	.89	2.03800.00
A03192	31			A	.00291.1553	.95	2.16800.00
A03192	32			A	.00311.1760	.95	2.29800.00
A03192	33			A	.00461.0304	1.90	3.17800.00
A03192	34			A	.0039 .9601	1.78	2.54800.00
A03192	35			A	.0036 .9859	1.59	2.41800.00
A03192	36			A	.0037 .9358	1.78	2.41800.00
A03192	37			A	.0041 .8961	2.03	2.54800.00
A03192	38			A	.0042 .8124	2.29	2.41800.00
A03192	39			A	.0030 .6327	1.90	1.40800.00
A03192	40			A	.0035 .6070	2.29	1.59800.00
A03192	41			A	.0042 .7188	2.54	2.22800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	– φ	X	Y RANGE
A03192	42			A	.0052 .9151	2.54	3.30800.00
A03192	43			A	.0037 .4444	2.67	1.27800.00
A03192	44			A	.0035 .3218	2.67	.89800.00
A03192	45			A	.0038 .3152	2.92	.95800.00
A03192	46			A	.0051 .3805	3.81	1.52800.00
A03192	47			A	.0058 .4883	4.06	2.16800.00
A03192	48			A	.0061 .2640	4.70	1.27800.00
A03192	49			A	.0048 .0997	3.81	.38800.00
A03192	50			A	.0056 .0288	4.44	.13800.00
A03192	51			A	.00143.1971	-1.14	-.06800.00
A03192	52			A	.00133.9270	-.76	-.76800.00
A03192	53			A	.00253.8363	-1.52	-1.27800.00
A03192	54			A	.00264.3319	-.76	-1.90800.00
A03192	55			A	.00334.2053	-1.27	-2.29800.00
A03192	56			A	.00314.2942	-1.02	-2.29800.00
A03192	57			A	.00424.4856	-.76	-3.30800.00
A03192	58			A	.00384.6707	-.13	-3.05800.00
A03192	59			A	.00115.4978	.63	-.63800.00
A03192	60			A	.00125.4071	.63	-.76800.00
A03192	61			A	.00155.6084	.95	-.76800.00
A03192	62			A	.00194.9786	.38	-1.40800.00
A03192	63			A	.00324.7124	.00	-2.54800.00
A03192	64			A	.00404.7124	.00	-3.17800.00
A03192	65			A	.00264.8977	.38	-2.03800.00
A03192	66			A	.00255.0341	.63	-1.90800.00
A03192	67			A	.00275.2023	1.02	-1.90800.00
A03192	68			A	.00245.5454	1.40	-1.27800.00
A03192	69			A	.00265.4340	1.40	-1.39800.00
A03192	70			A	.00295.4978	1.65	-1.65800.00
A03192	71			A	.0032 .0000	2.54	.00800.00
A03192	72			A	.00296.1180	2.29	-.38800.00
A03192	73			A	.00275.7932	1.90	-1.02800.00
A03192	74			A	.00295.7708	2.03	-1.14800.00
A03192	75			A	.00415.3871	2.03	-2.54800.00
A03192	76			A	.00445.4210	2.29	-2.67800.00
A03192	77			A	.00335.8847	2.41	-1.02800.00
A03192	78			A	.00345.7487	2.41	-1.27800.00
A03192	79			A	.00385.8007	2.67	-1.40800.00
A03192	80			A	.00542.4805	-3.43	2.67800.00
A03193	1			A	.00401.6902	-.38	3.17800.00
A03193	1			A	.00722.6387	-5.08	3.79800.00
A03193	2			A	.00261.8158	-.51	2.03800.00
A03193	2			A	.00592.6058	-4.06	2.41800.00
A03193	3			A	.00262.1421	-1.14	1.78800.00
A03193	3			A	.00497.8810	-3.81	1.02800.00
A03193	4			A	.00231.7475	-.32	1.78800.00
A03193	4			A	.00482.7367	-3.56	1.52800.00
A03193	5			A	.00242.1225	-1.02	1.65800.00
A03193	5			A	.00402.4117	-2.41	2.16800.00
A03193	6			A	.00232.0813	-.89	1.59800.00
A03193	6			A	.00392.0344	-1.40	2.79800.00
A03193	7			A	.00201.8158	-.38	1.52800.00
A03193	7			A	.00381.9591	-1.14	2.79800.00
A03193	8			A	.00181.6615	-.13	1.40800.00
A03193	8			A	.00351.9138	-.95	2.67800.00
A03193	9			A	.00172.3562	-.95	.95800.00
A03193	9			A	.00291.7359	-.38	2.29800.00
A03193	10			A	.00142.0344	-.51	1.02800.00
A03193	10			A	.00251.6332	-.13	2.03800.00
A03193	11			A	.00373.0119	-2.92	.38800.00
A03193	11			A	.00262.3996	-1.52	1.40800.00

SAMPLE	CELL	SEGMENT	PRIME	MFU	θ	φ	X	Y	RANGE
A03193	12			A	.0021	2.0315	-1.59	.51	800.00
A03193	12			A	.0021	2.0344	-.76	1.52	800.00
A03193	13			A	.0009	2.6779	-.[illegible]3	.32	800.00
A03193	13			A	.0018	2.0344	-.63	1.27	800.00
A03193	14			A	.0006	2.1584	-.25	.30	800.00
A03193	14			A	.0025	2.5360	-1.65	1.14	800.00
A03193	15			A	.0023	2.9649	-1.78	.32	800.00
A03193	15			A	.0032	2.[illegible]	-2.41	.76	800.00
A03193	16			A	.0019	2.9764	-1.52	.25	800.00
A03193	16			A	.0023	2.9305	-1.78	.38	800.00
A03193	17			A	.00[illegible]	[illegible].3562	-.13	.13	800.00
A03193	17			A	.0[illegible]	[illegible]2.7367	-.89	.38	800.00
A03193	18			A	.0003	3.1416	-.25	.00	800.00
A03193	18			A	.0005	3.1416	-.38	.00	800.00
A03193	19			A	.0004	.4636	.25	.13	800.00
A03193	19			A	.0001	.0000	.06	.00	800.00
A03193	20			A	.0010	1.2490	.25	.76	800.00
A03193	20			A	.0006	.7854	.32	.32	800.00
A03193	21			A	.0016	1.4711	.13	1.27	800.00
A03193	21			A	.0008	.6435	.51	.38	800.00
A03193	22			A	.0026	1.4464	.25	2.03	800.00
A03193	22			A	.0018	1.3473	.32	1.40	800.00
A03193	23			A	.0028	1.4289	.32	2.22	800.00
A03193	23			A	.0013	1.0808	.51	.95	800.00
A03193	24			A	.0030	1.4659	.25	2.41	800.00
A03193	24			A	.0011	.7854	.63	.63	800.00
A03193	25			A	.0033	1.5232	.13	2.67	800.00
A03193	25			A	.0025	.8761	1.27	1.52	800.00
A03193	26			A	.0036	1.5264	.13	2.86	800.00
A03193	26			A	.0019	.5404	1.27	.76	800.00
A03193	27			A	.0008	.1974	.63	.13	800.00
A03193	27			A	.0019	.4266	1.40	.63	800.00
A03193	28			A	.0010	.3948	.76	.32	800.00
A03193	28			A	.0013	.0624	1.02	.06	800.00
A03193	29			A	.0017	.8520	.89	1.02	800.00
A03193	29			A	.0022	.4475	1.59	.76	800.00
A03193	30			A	.0026	1.1903	.76	1.90	800.00
A03193	30			A	.0030	.5586	2.03	1.27	800.00
A03193	31			A	.0035	1.2925	.76	2.67	800.00
A03193	31			A	.0032	.5743	2.16	1.40	800.00
A03193	32			A	.0015	.2709	1.14	.32	800.00
A03193	32			A	.0033	.5071	2.29	1.27	800.00
A03193	33			A	.0019	.3488	1.40	.51	800.00
A03193	33			A	.0035	.6070	2.29	1.59	800.00
A03193	34			A	.0026	.5191	1.78	1.02	800.00
A03193	34			A	.0042	.8520	2.22	2.54	800.00
A03193	35			A	.0027	.4900	1.90	1.02	800.00
A03193	35			A	.0048	.9273	2.29	3.05	800.00
A03193	36			A	.0032	.6435	2.03	1.52	800.00
A03193	36			A	.0043	.6288	2.79	2.03	800.00
A03193	37			A	.0035	.8819	1.78	2.16	800.00
A03193	37			A	.0047	.6163	3.05	2.16	800.00
A03193	38			A	.0025	.0624	2.03	.13	800.00
A03193	38			A	.0038	.2954	2.92	.89	800.00
A03193	39			A	.0027	.0000	2.16	.00	800.00
A03193	39			A	.0047	.3805	3.49	1.40	800.00
A03193	40			A	.0028	.0571	2.22	.13	800.00
A03193	40			A	.0043	3.1786	-3.43	-.13	800.00
A03193	41			A	.0029	.2187	2.29	.51	800.00
A03193	41			A	.0021	3.3316	-1.65	-.32	800.00
A03193	42			A	.0033	.0476	2.67	.13	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	[illegible]	[illegible]	X	Y	RANGE
A03193	42			A	.0014	3.5004	-1.02	-.38	800.00
A03193	43			A	.0038	.0208	3.05	.06	800.00
A03193	43			A	.0004	4.2487	-.13	-.25	800.00
A03193	44			A	.0040	.3029	3.05	.95	800.00
A03193	44			A	.0007	4.4674	-.13	-.51	800.00
A03193	45			A	.0056	.6435	3.56	2.67	800.00
A03193	45			A	.0027	3.5004	-2.03	-.76	800.00
A03193	46			A	.0044	.0000	3.56	.00	800.00
A03193	46			A	.0023	5.5740	-1.65	-.76	800.00
A03193	47			A	.0048	.1326	3.81	.51	800.00
A03193	47			A	.0016	3.6487	-1.14	-.63	800.00
A03193	48			A	.0052	.3410	3.94	1.40	800.00
A03193	48			A	.0011	4.1843	-.44	-.76	800.00
A03193	49			A	.0055	.5281	3.81	2.22	800.00
A03193	49			A	.0025	3.8163	-1.59	-1.27	800.00
A03193	50			A	.0059	.1343	4.70	.63	800.00
A03193	50			A	.0019	4.0177	-.95	-1.14	800.00
A03193	51			A	.0016	3.2413	-1.27	-.13	800.00
A03193	51			A	.0013	4.3906	-.32	-.95	800.00
A03193	52			A	.0011	3.1416	-.89	.00	800.00
A03193	52			A	.0044	3.7494	-2.92	-2.03	800.00
A03193	53			A	.0010	3.8163	-.63	-.51	800.00
A03193	53			A	.0024	4.6458	-.13	-1.90	800.00
A03193	54			A	.0005	4.3906	-.13	-.38	800.00
A03193	54			A	.0054	3.8438	-3.30	-2.79	800.00
A03193	55			A	.0042	3.4513	-3.17	-1.02	800.00
A03193	55			A	.0047	3.8794	-2.79	-2.54	800.00
A03193	56			A	.0010	4.5472	-.13	-.76	800.00
A03193	56			A	.0034	4.5242	-.51	-2.67	800.00
A03193	57			A	.0018	4.2487	-.63	-1.27	800.00
A03193	57			A	.0066	4.0977	-3.05	-4.32	800.00
A03193	58			A	.0018	4.4889	-.32	-1.40	800.00
A03193	58			A	.0049	4.8089	.38	-3.94	800.00
A03193	59			A	.0019	4.6292	-.13	-1.52	800.00
A03193	59			A	.0013	4.9574	.25	-1.02	800.00
A03193	60			A	.0050	3.9158	-2.8[illegible]	-2.79	800.00
A03193	60			A	.0007	6.0382	.51	-.13	800.00
A03193	61			A	.0033	4.4209	-.76	-2.54	800.00
A03193	61			A	.0017	5.0929	.51	-1.27	800.00
A03193	62			A	.0053	4.1822	-2.16	-3.68	800.00
A03193	62			A	.0041	4.9854	.89	-[illegible].17	800.00
A03193	63			A	.0001	5.4978	.06	-.26	800.00
A03193	63			A	.0037	5.1568	1.27	-2.67	800.00
A03193	64			A	.0025	6.2519	2.03	-.06	800.00
A03193	64			A	.0016	5.1306	.51	-1.14	800.00
A03193	65			A	.0049	6.2671	3.94	-.06	800.00
A03193	65			A	.0012	5.5884	.76	-.63	800.00
A03193	66			A	.0015	5.9614	[illegible].14	-.38	800.00
A03193	66			A	.0014	[illegible].6952	.95	-.63	800.00
A03193	67			A	.0020	6.0855	1.59	-.32	800.00
A03193	67			A	.0011	5.8[illegible]95	.76	-.38	800.00
A03193	68			A	.0027	6.1372	2.16	-.32	800.00
A03193	68			A	.0016	6.1835	1.27	-.13	800.00
A03193	69			A	.0054	6.2244	4.32	-.25	800.00
A03193	69			A	.0022	6.2119	1.78	-.13	800.00
A03193	70			A	.0010	5.0341	.25	-.76	800.00
A03193	70			A	.0020	5.7838	1.40	-.76	800.00
A03193	71			A	.0024	5.8783	1.78	-.76	800.00
A03193	71			A	.0022	5.8357	1.59	-.76	800.00
A03193	72			A	.0039	5.9484	2.92	-1.02	800.00
A03193	72			A	.0023	5.7428	1.59	-.95	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ φ	X	Y RANGE
A03193	73			A	.00194.9178	.32	-1.52800.00
A03193	73			A	.00215.5504	1.27	-1.14800.00
A03193	74			A	.00195.1390	.63	-1.40800.00
A03193	74			A	.00246.1180	1.90	-.32800.00
A03193	75			A	.00235.3004	1.02	-1.52800.00
A03193	75			A	.00265.9027	1.90	-.76800.00
A03193	76			A	.00255.6776	1.65	-1.14800.00
A03193	76			A	.00276.1372	2.16	-.32800.00
A03193	77			A	.00375.8388	2.67	-1.27800.00
A03193	77			A	.00296.0911	2.29	-.44800.00
A03193	78			A	.00405.8371	2.92	-1.40800.00
A03193	78			A	.00356.1033	2.79	-.51800.00
A03193	79			A	.00565.8764	4.13	-1.78800.00
A03193	79			A	.00335.7346	2.29	-1.40800.00
A03193	80			A	.00344.8543	.38	-2.67800.00
A03193	80			A	.00415.6084	2.54	-2.03800.00
A03194	1			A	.00431.8338	-.89	3.30800.00
A03194	2			A	.00332.0132	-1.14	2.41800.00
A03194	3			A	.00311.9417	-.89	2.29800.00
A03194	4			A	.00291.7895	-.51	2.29800.00
A03194	5			A	.00271.6879	-.25	2.16800.00
A03194	6			A	.00332.2531	-1.65	2.03800.00
A03194	7			A	.00272.1910	-1.27	1.78800.00
A03194	8			A	.00201.7295	-.25	1.59800.00
A03194	9			A	.00242.2143	-1.14	1.52800.00
A03194	10			A	.00272.6779	-1.90	.95800.00
A03194	11			A	.00212.5749	-1.40	.89800.00
A03194	12			A	.00213.1416	-1.65	.00800.00
A03194	13			A	.00132.8966	-1.02	.25800.00
A03194	14			A	.00082.4981	-.51	.38800.00
A03194	15			A	.00031.5708	.00	.25800.00
A03194	16			A	.00051.2490	.13	.38800.00
A03194	17			A	.00091.0304	.38	.63800.00
A03194	18			A	.00131.1903	.38	.95800.00
A03194	19			A	.00211.4181	.25	1.65800.00
A03194	20			A	.00371.4841	.25	2.92800.00
A03194	21			A	.0009 .3805	.63	.25800.00
A03194	22			A	.0010 .6747	.63	.51800.00
A03194	23			A	.00291.2315	.76	2.16800.00
A03194	24			A	.00301.2998	.63	2.29800.00
A03194	25			A	.0019 .6947	1.14	.95800.00
A03194	26			A	.00261.0517	1.02	1.78800.00
A03194	27			A	.00381.1442	1.27	2.79800.00
A03194	28			A	.00471.2278	1.27	3.56800.00
A03194	29			A	.0019 .1651	1.52	.25800.00
A03194	30			A	.0019 .3488	1.40	.51800.00
A03194	31			A	.0030 .8961	1.52	1.90800.00
A03194	32			A	.0023 .4939	1.65	.89800.00
A03194	33			A	.0036 .8961	1.78	2.22800.00
A03194	34			A	.0026 .1853	2.03	.38800.00
A03194	35			A	.0026 .2450	2.03	.51800.00
A03194	36			A	.0029 .3906	2.16	.89800.00
A03194	37			A	.0032 .1489	2.54	.38800.00
A03194	38			A	.0038 .5764	2.54	1.65800.00
A03194	39			A	.0045 .6470	2.86	2.16800.00
A03194	40			A	.0040 .1194	3.17	.38800.00
A03194	41			A	.0050 .2915	3.81	1.14800.00
A03194	42			A	.00063.2659	-.51	-.06800.00
A03194	43			A	.00094.3319	-.25	-.63800.00
A03194	44			A	.00104.5472	-.13	-.76800.00
A03194	45			A	.00103.8163	-.63	-.51800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	φ	θ	X	Y	RANGE
A03194	46			A	.0013	4.2224	-.51	-.95	800.00
A03194	47			A	.0017	4.3319	-.51	-1.27	800.00
A03194	48			A	.0021	4.4027	-.51	-1.59	800.00
A03194	49			A	.0023	3.3183	-1.78	-.32	800.00
A03194	50			A	.0019	3.8363	-1.14	-.95	800.00
A03194	51			A	.0033	3.8925	-1.90	-1.78	800.00
A03194	52			A	.0036	4.1491	-1.52	-2.41	800.00
A03194	53			A	.0041	3.4146	-3.17	-.89	800.00
A03194	54			A	.0041	3.7083	-2.79	-1.78	800.00
A03194	55			A	.0045	4.0759	-2.16	-2.92	800.00
A03194	56			A	.0008	6.0858	.63	-.13	800.00
A03194	57			A	.0021	6.2064	1.65	-.13	800.00
A03194	58			A	.0018	6.0169	1.40	-.38	800.00
A03194	59			A	.0009	5.0929	.25	-.63	800.00
A03194	60			A	.0010	5.0341	.25	-.76	800.00
A03194	61			A	.0013	5.2315	.51	-.89	800.00
A03194	62			A	.0018	5.4978	1.02	-1.02	800.00
A03194	63			A	.0025	5.8195	1.78	-.89	800.00
A03194	64			A	.0017	4.7578	.06	-1.40	800.00
A03194	65			A	.0034	5.7987	2.41	-1.27	800.00
A03194	66			A	.0020	4.9479	.38	-1.59	800.00
A03194	67			A	.0024	5.2640	1.02	-1.65	800.00
A03194	68			A	.0034	5.6952	2.29	-1.52	800.00
A03194	69			A	.0024	4.7124	.00	-1.90	800.00
A03194	70			A	.0034	5.4312	1.78	-2.03	800.00
A03194	71			A	.0038	5.4978	2.16	-2.16	800.00
A03194	72			A	.0031	4.8690	.38	-2.41	800.00
A03194	73			A	.0032	5.1760	1.14	-2.29	800.00
A03194	74			A	.0040	5.4423	2.16	-2.41	800.00
A03194	75			A	.0043	5.4978	2.41	-2.41	800.00
A03194	76			A	.0049	5.5323	2.86	-2.67	800.00
A03194	77			A	.0052	5.1897	1.90	-3.68	800.00
A03194	78			A	.0054	4.7711	.25	-4.32	800.00
A03194	79			A	.0056	4.9712	1.14	-4.32	800.00
A03195	1			A	.0050	1.8925	-1.27	3.81	800.00
A03195	2			A	.0065	2.5128	-4.19	3.05	800.00
A03195	3			A	.0041	1.8063	-.76	3.17	800.00
A03195	4			A	.0062	2.5393	-4.06	2.79	800.00
A03195	5			A	.0039	1.9890	-1.27	2.86	800.00
A03195	6			A	.0035	1.7063	-.38	2.79	800.00
A03195	7			A	.0035	1.5708	.00	2.79	800.00
A03195	8			A	.0080	2.8823	-6.22	1.65	800.00
A03195	9			A	.0028	1.7955	-.51	2.22	800.00
A03195	10			A	.0051	2.8590	-3.94	1.14	800.00
A03195	11			A	.0065	3.0443	-5.21	.51	800.00
A03195	12			A	.0013	2.8387	-1.02	.32	800.00
A03195	13			A	.0066	1.0427	2.67	4.57	800.00
A03195	14			A	.0048	1.4713	.38	3.81	800.00
A03195	15			A	.0049	1.3258	.95	3.81	800.00
A03195	16			A	.0050	1.2793	1.14	3.81	800.00
A03195	17			A	.0043	1.1903	1.27	3.17	800.00
A03195	18			A	.0036	1.4601	.32	2.86	800.00
A03195	19			A	.0032	1.4218	.38	2.54	800.00
A03195	20			A	.0036	1.3045	.76	2.79	800.00
A03195	21			A	.0038	.9025	1.90	2.41	800.00
A03195	22			A	.0065	.4528	4.70	2.29	800.00
A03195	23			A	.0021	1.3961	.38	2.16	800.00
A03195	24			A	.0022	1.4995	.13	1.78	800.00
A03195	25			A	.0023	1.1384	.76	1.65	800.00
A03195	26			A	.0067	.3142	5.08	1.65	800.00
A03195	27			A	.0019	1.5292	.06	1.52	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	ψ	φ	X	Y	RANGE
A03195	28			A	.0030	.6327	1.90	1.40	800.00
A03195	29				.0036	.5028	2.54	1.40	800.00
A03195	30			A	.0016	1.1526	.51	1.14	800.00
A03195	31			A	.0032	.3530	2.41	.89	800.00
A03195	32			A	.0057	.2247	4.44	1.02	800.00
A03195	33			A	.0010	1.2490	.25	.76	800.00
A03195	34			A	.0061	.1566	4.83	.76	800.00
A03195	35			A	.0009	1.0304	.38	.63	800.00
A03195	36			A	.0015	.5586	1.02	.63	800.00
A03195	37			A	.0006	.5880	.38	.25	800.00
A03195	38			A	.0020	.2450	1.52	.38	800.00
A03195	39			A	.0020	.0000	1.59	.00	800.00
A03195	40			A	.0067	3.4783	-5.08	-1.78	800.00
A03195	41			A	.0029	3.3603	-2.29	-.51	800.00
A03195	42			A	.0030	3.5221	-2.22	-.89	800.00
A03195	43			A	.0024	3.5465	-1.78	-.76	800.00
A03195	44			A	.0015	3.7002	-1.02	-.63	800.00
A03195	45			A	.0013	4.1932	-.51	-.89	800.00
A03195	46			A	.0016	4.6127	-.13	-1.27	800.00
A03195	47			A	.0026	4.1411	-1.14	-1.78	800.00
A03195	48			A	.0022	4.5705	-.25	-1.78	800.00
A03195	49			A	.0032	4.0492	-1.59	-2.03	800.00
A03195	50			A	.0034	4.1113	-1.52	-2.22	800.00
A03195	51			A	.0032	4.4065	-.76	-2.41	800.00
A03195	52			A	.0035	4.2895	-1.14	-2.54	800.00
A03195	53			A	.0038	4.3708	-1.02	-2.[illegible]	800.00
A03195	54			A	.0039	4.4674	-.76	-3.05	800.00
A03195	55			A	.0046	4.6435	-.25	-3.68	800.00
A03195	56			A	.0004	5.4978	.25	-.25	800.00
A03195	57			A	.0005	5.9614	.38	-.13	800.00
A03195	58			A	.0010	6.1180	.76	-.13	800.00
A03195	59			A	.0011	5.8195	.76	-.38	800.00
A03195	60			A	.0016	5.5323	.95	-.89	800.00
A03195	61			A	.0044	6.0295	3.43	-.89	800.00
A03195	62			A	.0065	6.0858	5.08	-1.02	800.00
A03195	63			A	.0018	4.8030	.13	-1.40	800.00
A03195	64			A	.0020	5.3559	.95	-1.27	800.00
A03195	65			A	.0026	5.5615	1.59	-1.40	800.00
A03195	66			A	.0040	5.8371	2.92	-1.40	800.00
A03195	67			A	.0025	5.1760	.89	-1.78	800.00
A03195	68			A	.0028	5.4578	1.52	-1.65	800.00
A03195	69			A	.0040	5.4837	2.22	-2.29	800.00
A03195	70			A	.0067	5.9426	5.02	-1.78	800.00
A03195	71			A	.0027	5.0153	.63	-2.03	800.00
A03195	72			A	.0034	5.4978	1.90	-1.90	800.00
A03195	73			A	.0033	5.3271	1.52	-2.16	800.00
A03195	74			A	.0043	5.6027	2.67	-2.16	800.00
A03195	75			A	.0058	5.8317	4.19	-2.03	800.00
A03195	76			A	.0035	5.1760	1.27	-2.54	800.00
A03195	77			A	.0035	5.0554	.95	-2.67	800.00
A03195	78			A	.0050	5.0341	1.27	-3.81	800.00
A03195	79			A	.0054	4.8295	.51	-4.32	800.00
A03195	80			A	.0055	5.1248	1.78	-4.06	800.00
A03196	1			A	.0086	1.6815	-.76	6.86	800.00
A03196	2			A	.0068	1.8778	-1.65	5.21	800.00
A03196	3			A	.0057	1.8225	-1.14	4.44	800.00
A03196	4			A	.0058	1.7088	-.63	4.57	800.00
A03196	5			A	.0053	2.4199	-3.17	2.79	800.00
A03196	6			A	.0044	2.0183	-1.52	3.17	800.00
A03196	7			A	.0043	1.8693	-1.02	3.30	800.00
A03196	8			A	.0040	2.0169	-1.40	2.92	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03196	9			A	.0037	1.6142	-.13	2.92	800.00
A03196	10			A	.0041	2.1212	-1.71	2.79	800.00
A03196	11			A	.0038	2.0899	-1.52	2.67	800.00
A03196	12			A	.0035	1.8925	-.89	2.67	800.00
A03196	13			A	.0044	2.3818	-2.54	2.41	800.00
A03196	14			A	.0030	1.6234	-.13	2.41	800.00
A03196	15			A	.0038	2.3562	-2.16	2.16	800.00
A03196	16			A	.0025	2.0344	-.89	1.72	800.00
A03196	17			A	.0028	2.3162	-1.52	1.65	800.00
A03196	18			A	.0028	2.1745	-1.27	1.84	800.00
A03196	19			A	.0024	2.0491	-.89	1.71	800.00
A03196	20			A	.0021	2.0344	-.76	1.52	800.00
A03196	21			A	.0020	1.8063	-.38	1.59	800.00
A03196	22			A	.0018	1.6615	-.13	1.40	800.00
A03196	23			A	.0045	2.9997	-3.56	.51	800.00
A03196	24			A	.0025	2.6498	-1.78	.95	800.00
A03196	25			A	.0013	1.6952	-.13	1.02	800.00
A03196	26			A	.0080	1.4219	.95	6.35	800.00
A03196	27			A	.0052	1.5405	.13	4.19	800.00
A03196	28			A	.0051	1.3334	.95	3.94	800.00
A03196	29			A	.0062	.80[illegible]6	3.43	3.56	800.00
A03196	30			A	.0040	1.4711	.32	3.17	800.00
A03196	31			A	.0042	1.2611	1.02	3.17	800.00
A03196	32			A	.0035	1.5234	.13	2.79	800.00
A03196	33			A	.0043	.9420	2.03	2.79	800.00
A03196	34			A	.0053	.7217	3.17	2.79	800.00
A03196	35			A	.0056	.6747	3.49	2.79	800.00
A03196	36			A	.0029	1.1553	.95	2.16	800.00
A03196	37			A	.0016	1.4711	.13	1.27	800.00
A03196	38			A	.0021	.8380	1.14	1.27	800.00
A03196	39			A	.0030	.6327	1.90	1.40	800.00
A03196	40			A	.0040	.4461	2.92	1.40	800.00
A03196	41			A	.0047	.3430	3.56	1.27	800.00
A03196	42			A	.0050	.3218	3.81	1.27	800.00
A03196	43			A	.0029	.5124	2.03	1.14	800.00
A03196	44			A	.0051	.2576	3.94	1.02	800.00
A03196	45			A	.0023	.4324	1.65	.76	800.00
A03196	46			A	.0036	.2235	2.79	.63	800.00
A03196	47			A	.0045	.2148	3.49	.76	800.00
A03196	48			A	.0009	.5404	.63	.38	800.00
A03196	49			A	.0052	.0303	4.19	.13	800.00
A03196	50			A	.0022	3.21[illegible]9	-1.78	-.13	800.00
A03196	51			A	.0014	[illegible].416	-1.14	.06	800.00
A03196	52			A	.0008	3.1416	-.63	.00	800.00
A03196	53			A	.0027	3.3163	-2.16	-.38	800.00
A03196	54			A	.0018	3.3214	-1.40	-.25	800.00
A03196	55			A	.0005	3.8163	-.32	-.25	800.00
A03196	56			A	.0011	4.7124	.00	-.89	800.00
A03196	57			A	.0035	3.5644	-2.54	-1.14	800.00
A03196	58			A	.0029	3.9074	-1.65	-1.59	800.00
A03196	59			A	.0020	4.2130	-.76	-1.40	800.00
A03196	60			A	.0031	4.1807	-1.27	-2.16	800.00
A03196	61			A	.0037	4.1720	-1.52	-2.54	800.00
A03196	62			A	.0031	4.5558	-.38	-2.41	800.00
A03196	63			A	.0038	4.4572	-.76	-2.92	800.00
A03196	64			A	.0048	4.1891	-1.90	-3.30	800.00
A03196	65			A	.0051	4.3319	-1.52	-3.81	800.00
A03196	66			A	.0052	4.3714	-1.40	-3.94	800.00
A03196	67			A	.0078	4.1807	-3.17	-5.40	800.00
A03196	68			A	.0013	5.9027	.95	-.38	800.00
A03196	69			A	.0067	6.2119	5.33	-.38	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	·· ◇	X	Y RANGE
A03196	70			A	.00215.9027	1.59	-.63800.00
A03196	71			A	.00154.9311	.25	-1.14800.00
A03196	72			A	.00335.7220	2.22	-1.40800.00
A03196	73			A	.00265.2315	1.02	-1.78800.00
A03196	74			A	.00705.9614	5.33	-1.78800.00
A03196	75			A	.00405.2291	1.59	-2.79800.00
A03196	76			A	.00455.1126	1.40	-3.30800.00
A03196	77			A	.00515.3435	2.41	-3.30800.00
A03196	78			A	.00614.8690	.76	-4.83800.00
A03196	79			A	.00835.4774	4.57	-4.76800.00
A03196	80			A	.00744.9833	1.59	-5.71800.00
A03200	1			A	.00682.7305	-4.95	2.16800.00
A03200	2			A	.00452.4062	-2.67	2.41800.00
A03200	3			A	.00291.9101	-.76	2.16800.00
A03200	4			A	.00292.0591	-1.08	2.03800.00
A03200	5			A	.00302.2455	-1.52	1.90800.00
A03200	6			A	.00392.5873	-2.67	1.65800.00
A03200	7			A	.00362.6387	-2.54	1.40800.00
A03200	8			A	.00182.3562	-1.02	1.02800.00
A03200	9			A	.00161.6705	-.13	1.27800.00
A03200	10			A	.00222.7744	-1.65	.63800.00
A03200	11			A	.00493.1255	-3.94	.06800.00
A03200	12			A	.00353.0962	-2.79	.13800.00
A03200	13			A	.00112.6779	-.76	.38800.00
A03200	14			A	.00641.5458	.13	5.02800.00
A03200	15			A	.00681.3826	1.02	5.33800.00
A03200	16			A	.00581.3767	.89	4.57800.00
A03200	17			A	.00531.3909	.76	4.19800.00
A03200	18			A	.00541.3045	1.14	4.19800.00
A03200	19			A	.00401.4514	.38	3.17800.00
A03200	20			A	.00441.1233	1.52	3.17800.00
A03200	21			A	.0055 .8465	2.92	3.30800.00
A03200	22			A	.00391.3258	.76	3.05800.00
A03200	23			A	.00401.2670	.89	3.05800.00
A03200	24			A	.00341.1903	1.02	2.54800.00
A03200	25			A	.0059 .4327	3.81	2.79800.00
A03200	26			A	.00271.3961	.38	2.16800.00
A03200	27			A	.00191.4877	.13	1.52800.00
A03200	28			A	.00221.2723	.51	1.65800.00
A03200	29			A	.0051 .4706	3.62	1.84800.00
A03200	30			A	.00161.0637	.63	1.14800.00
A03200	31			A	.0048 .4049	3.56	1.52800.00
A03200	32			A	.0041 .3948	3.05	1.27800.00
A03200	33			A	.0026 .3805	1.90	.76800.00
A03200	34			A	.0040 .3218	3.05	1.02800.00
A03200	35			A	.0024 .3430	1.78	.63800.00
A03200	36			A	.0029 .3393	2.16	.76800.00
A03200	37			A	.0040 .1974	3.17	.63800.00
A03200	38			A	.0018 .2235	1.40	.32800.00
A03200	39			A	.0024 .0666	1.90	.13800.00
A03200	40			A	.00723.2302	-5.71	-.51800.00
A03200	41			A	.00543.3476	-4.25	-.89800.00
A03200	42			A	.00223.5891	-1.59	-.76800.00
A03200	43			A	.00443.9014	-2.54	-2.41800.00
A03200	44			A	.00354.3906	-.89	-2.67800.00
A03200	45			A	.00604.2487	-2.16	-4.32800.00
A03200	46			A	.0006 .0000	.51	.00800.00
A03200	47			A	.00104.8775	.13	-.76800.00
A03200	48			A	.00105.3871	.51	-.63800.00
A03200	49			A	.00165.8650	1.14	-.51900.00
A03200	50			A	.00206.0382	1.52	-.38800.00

SAMPLE	CELL	SEGMENT	PRIME	MFC		X	Y RANGE
A0320C	51			A	.0C246.0858	1.90	-.39800.0[illegible]
A0320C	52			A	.0C286.1694	2.22	-.[illegible]5800.00
A0320C	53			A	.0C316.1266	2.41	-.[illegible]C.00
A03200	54			A	.0C346.1904	2.73	-.[illegible]C.C0
A0320C	55			A	.0C155.4710	.76	-.59800.C0
A0320C	56			A	.0C185.8195	1.27	-.63[illegible]C.C0
A0320C	57			A	.0C215.6849	1.40	-.55[illegible]C.[illegible]
A0320C	58			A	.0C666.0832	4.[illegible]	-.55800.[illegible]
A0320C	59			A	.0C195.0612	.51	-1.40800.00
A0320C	60			A	.0C195.2528	.76	-1.27800.C0
A0320C	61			A	.0C195.4390	1.02	-1.14800.C0
A0320C	62			A	.0C245.5454	1.40	-1.27800.00
A0320C	63			A	.0C255.6776	1.65	-1.14800.00
A0320C	64			A	.0C335.7346	2.29	-1.40800.00
A0320C	65			A	.0C245.4502	1.27	-1.40800.00
A0320C	66			A	.0C285.5182	1.59	-1.52900.C0
A0320C	67			A	.0C244.8449	.25	-1.90800.00
A0320C	68			A	.0C285.2528	1.14	-1.90800.00
A0320C	69			A	.0C305.4412	1.59	-1.78800.00
A0320C	70			A	.0C335.6099	2.C3	-1.65800.C0
A0320C	71			A	.0C355.6577	2.29	-1.65800.C0
A0320C	72			A	.0C635.9215	4.70	-1.78800.00
A0320C	73			A	.0C254.7695	.13	-2.22900.00
A0320C	74			A	.0C355.4655	1.90	-2.03800.C0
A0320C	75			A	.0C385.4390	2.C3	-2.29800.00
A0320C	76			A	.0C344.8543	.38	-2.67800.00
A0320C	77			A	.0C385.3807	1.90	-2.41800.00
A0320C	78			A	.0C655.7428	4.44	-2.67800.C0
A0320C	79			A	.0C405.2291	1.59	-2.79800.00
A0320C	80			A	.0C505.0038	1.14	-3.91800.00
A03201	1			A	.01112.7928	-8.38	3.05800.00
A03201	2			A	.0C752.4307	-4.57	3.94800.00
A03201	3			A	.0C872.9585	-6.86	1.27800.00
A03201	4			A	.0C372.3259	-2.03	2.16800.00
A03201	5			A	.0C252.0626	-.95	1.78800.00
A03201	6			A	.0C221.7127	-.25	1.78800.00
A03201	7			A	.0C211.8805	-.51	1.59800.00
A03201	8			A	.0C192.0344	-.63	1.27800.00
A03201	9			A	.0C452.9305	-3.56	.76800.00
A03201	10			A	.00482.9764	-3.81	.63800.00
A03201	11			A	.0C182.3562	-1.02	1.02800.C0
A03201	12			A	.0C151.8925	-.38	1.14800.00
A03201	13			A	.0C162.6345	-1.14	.63800.00
A03201	14			A	.0C101.6539	-.06	.76800.C0
A03201	15			A	.0C413.0649	-3.30	.25800.C0
A03201	16			A	.0C182.9617	-1.40	.25800.00
A03201	17			A	.0C092.6012	-.63	.38800.00
A03201	18			A	.0C323.1416	-2.54	.00800.00
A03201	19			A	.0C133.0172	-1.02	.13800.00
A03201	20			A	.0C103.1416	-.76	.00800.C0
A03201	21			A	.0C731.2940	1.59	5.59800.C0
A03201	22			A	.0C671.3316	1.27	5.21800.C0
A03201	23			A	.0C681.2861	1.52	5.21800.C0
A03201	24			A	.00431.5523	.06	3.43800.C0
A03201	25			A	.0C401.5708	.00	3.17800.C0
A03201	26			A	.0C381.4466	.38	3.05800.C0
A03201	27			A	.0C371.2220	1.02	2.79800.CC
A03201	28			A	.0C211.5324	.06	1.65800.C0
A03201	29			A	.0C261.1342	.89	1.90800.CC
A03201	30			A	.0C28 .9048	1.40	1.78800.00
A03201	31			A	.0C34 .7183	2.C3	1.78800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A03201	32			A	.0043	.5880	2.86	1.90	800.00
A03201	33			A	.0010	1.3473	.32	1.40	800.00
A03201	34			A	.0024	.8330	1.27	1.40	800.00
A03201	35			A	.0036	.5028	2.54	1.40	800.00
A03201	36			A	.0040	.4461	2.92	1.40	800.00
A03201	37			A	.0054	.2663	4.19	1.14	800.00
A03201	38			A	.0012	1.5042	.06	.95	800.00
A03201	39			A	.0015	1.2998	.32	1.14	800.00
A03201	40			A	.0015	1.2490	.38	1.14	800.00
A03201	41			A	.0028	.4636	2.03	1.02	800.00
A03201	42			A	.0011	1.1071	.38	.76	800.00
A03201	43			A	.0016	.6435	1.02	.76	800.00
A03201	44			A	.0020	.4993	1.40	.76	800.00
A03201	45			A	.0023	.4324	1.65	.76	800.00
A03201	46			A	.0013	.5191	.89	.51	800.00
A03201	47			A	.0008	.1974	.63	.13	800.00
A03201	48			A	.0015	.2709	1.14	.32	800.00
A03201	49			A	.0056	3.1559	-4.44	-.06	800.00
A03201	50			A	.0052	3.1719	-4.19	-.13	800.00
A03201	51			A	.0048	3.1583	-3.61	-.06	800.00
A03201	52			A	.0029	3.2522	-2.29	-.25	800.00
A03201	53			A	.0003	3.3866	-.25	-.06	800.00
A03201	54			A	.0020	3.6409	-1.40	-.76	800.00
A03201	55			A	.00[illegible]7	4.6670	-.06	-1.40	800.00
A03201	56			A	.0024	4.5130	-.38	-1.90	800.00
A03201	57			A	.0044	6.7124	.00	-3.56	800.00
A03201	58			A	.0003	6.0382	.25	-.06	800.00
A03201	59			A	.0010	6.1180	.76	-.13	800.00
A03201	60			A	.0013	6.1588	1.02	-.13	800.00
A03201	61			A	.0025	6.2519	2.03	-.06	800.00
A03201	62			A	.0011	5.8195	.76	-.38	800.00
A03201	63			A	.0015	5.9614	1.14	-.38	800.00
A03201	64			A	.0018	6.1033	1.40	-.25	800.00
A03201	65			A	.0021	6.1305	1.65	-.25	800.00
A03201	66			A	.0038	6.1588	3.05	-.38	800.00
A03201	67			A	.0011	5.1760	.38	-.76	800.00
A03201	68			A	.0015	5.8566	1.40	-.63	800.00
A03201	69			A	.0024	5 9402	1.78	-.63	800.00
A03201	70			A	.0048	6.1130	3.81	-.63	800.00
A03201	71			A	.0053	6.[illegible]	4.19	-.51	800.00
A03201	72			A	.0024	5.7599	1.65	-.95	800.00
A03201	73			A	.0053	6.0710	4.13	-.89	800.00
A03201	74			A	.0025	5.6084	1.59	-1.27	800.00
A03201	75			A	.0056	5.9971	4.32	-1.27	800.00
A03201	76			A	.0021	5.0221	.51	-1.59	800.00
A03201	77			A	.0024	4.7790	.13	-1.90	800.00
A03201	78			A	.0032	5.3559	1.52	-2.03	800.00
A03201	79			A	.0036	4.9574	.70	-2.79	800.00
A03201	80			A	.0065	4.9337	1.14	-5.08	800.00
A03202	1			A	.0134	2.7787	-10.03	3.81	800.00
A03202	2			A	.0118	2.7111	-8.57	3.94	800.00
A03202	3			A	.0060	1.8925	-1.52	4.57	800.00
A03202	4			A	.0041	2.0517	-1.52	2.92	800.00
A03202	5			A	.0030	2.0899	-1.52	2.67	800.00
A03202	6			A	.0046	2.4669	-2.86	2.29	800.00
A03202	7			A	.0029	1.9614	-.89	2.16	800.00
A03202	8			A	.0029	1.8491	-.63	2.22	800.00
A03202	9			A	.0027	1.5708	.00	2.16	800.00
A03202	10			A	.0034	2.3562	-[illegible].90	1.90	800.00
A03202	11			A	.0085	2.9718	-6.67	1.14	800.00
A03202	12			A	.0066	2.8501	-5.08	1.52	800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG		X	Y RANGE
A03202	13			A	.00211.6092	-.06	1.65800.00
A03202	14			A	.00171.6162	-.06	1.40800.00
A03202	15			A	.00161.7682	-.25	1.27800.00
A03202	16			A	.00162.3217	-.89	.95800.00
A03202	17			A	.00603.0883	-4.76	.25800.00
A03202	18			A	.00563.1130	-4.44	.13800.00
A03202	19			A	.00442.9972	-3.49	.51800.00
A03202	20			A	.00232.8633	-1.78	.51800.00
A03202	21			A	.00162.9442	-1.27	.25800.00
A03202	22			A	.00052.6779	-.38	.19800.00
A03202	23			A	.00062.1588	-.25	.38800.00
A03202	24			A	.00461.4848	.32	3.68800.00
A03202	25			A	.0037 .9358	1.78	2.41800.00
A03202	26			A	.0046 .7610	2.67	2.54800.00
A03202	27			A	.0053 .6375	3.43	2.54800.00
A03202	28			A	.0026 .9151	1.27	1.65800.00
A03202	29			A	.0054 .4242	3.94	1.78800.00
A03202	30			A	.0044 .3672	3.30	1.27800.00
A03202	31			A	.0012 .6947	.76	.63800.00
A03202	32			A	.0030 .3218	2.29	.76800.00
A03202	33			A	.0047 .2040	3.68	.76800.00
A03202	34			A	.0013 .4900	.95	.51800.00
A03202	35			A	.0024 .1651	1.90	.32800.00
A03202	36			A	.0039 .1618	3.11	.51800.00
A03202	37			A	.0065 .0609	5.21	.32800.00
A03202	38			A	.0008 .1974	.63	.13800.00
A03202	39			A	.0017 .0000	1.40	.00800.00
A03202	40			A	.0038 .0416	3.05	.13800.00
A03202	41			A	.0033 .0000	2.67	.00800.00
A03202	42			A	.00643.2165	-5.08	-.38800.00
A03202	43			A	.00433.2887	-3.43	-.51800.00
A03202	44			A	.00283.3727	-2.16	-.51800.00
A03202	5			A	.00203.3866	-1.52	-.38800.00
A03202	46			A	.00163.5598	-1.14	-.51800.00
A03202	47			A	.00044.3319	-.13	-.32800.00
A03202	48			A	.00064.5860	-.06	-.51800.00
A03202	49			A	.00094.2487	-.32	-.63800.00
A03202	50			A	.00134.1932	-.51	-.89800.00
A03202	51			A	.00383.6607	-2.67	-1.52800.00
A03202	52			A	.00363.9894	-1.90	-2.16800.00
A03202	53			A	.00304.3319	-.89	-2.22800.00
A03202	54			A	.00284.4877	-.51	-2.22800.00
A03202	55			A	.00474.5084	-.76	-3.68800.00
A03202	56			A	.00903.9894	-4.76	-5.40800.00
A03202	57			A	.0041 .0000	3.30	.00800.00
A03202	58			A	.00276.1661	2.16	-.25800.00
A03202	59			A	.00085.3559	.38	-.51800.00
A03202	60			A	.00095.4978	.51	-.51800.00
A03202	61			A	.00186.0169	1.40	-.38800.00
A03202	62			A	.00236.0721	1.78	-.38800.00
A03202	63			A	.00256.0226	1.90	-.51800.00
A03202	64			A	.00306.1524	2.41	-.32800.00
A03202	65			A	.00356.1925	2.79	-.25800.00
A03202	66			A	.00114.8543	.13	-.89800.00
A03202	67			A	.00105.3871	.51	-.63800.00
A03202	68			A	.00135.2315	.51	-.89800.00
A03202	69			A	.00175.5644	1.02	-.89800.00
A03202	70			A	.00375.9616	2.86	-.89800.00
A03202	71			A	.00406.0858	3.17	-.63800.00
A03202	72			A	.00916.1783	7.24	-.76800.00
A03202	73			A	.00195.4390	1.02	-1.14800.00

SAMPLE	CELL	SEGMENT	PRIME	MFG	θ	φ	X	Y	RANGE
A032C2	74			A	.0C24	5.6397	1.52	-1.14	8CC.00
A03202	75			A	.0C22	5.1599	.76	-1.59	800.00
A032G2	76			A	.0043	5.7364	2.92	-1.78	8CC.C0
A03202	77			A	.0C34	5.0491	.89	-2.54	800.C0
A03202	78			A	.0045	5.6467	2.92	-2.16	800.00
A03202	79			A	.0C38	5.0540	1.C2	-2.86	8CC.00
A03202	80			A	.0C73	4.9C98	1.14	-5.71	8CC.C0

Appendix B
DIRECTIONAL REFLECTANCE (ρ_d) AND EMITTANCE (ϵ_d)

This appendix contains computer plots of all of the spectral directional reflectance and spectral emittance data provided to AVCO on both the AVCO and SAMSO programs. The spectral directional reflectance data taken at ERIM comprise the majority of the data contained here; however, the data taken by other groups and put into the ERAS format by ERIM is also included in the data presented. All measurements were made at ambient room temperature unless otherwise specified. A description of the ERAS format can be found in Appendix F of this report.

The plots are arranged, two to a page, with wavelength on the abscissa and either the percent reflectance (ρ_d) or emittance (ϵ_d) on the ordinate. Above each plot (starting from the left), is the sample number which is a four-digit number preceded by an AO. The sample number is followed by a three-digit number in which the first digit denotes the area being measured and the second two digits indicate a change in the measurement parameter on a particular area. The sample and area condition (A/C) numbers are then followed by a sample title.

To find a particular curve for a particular sample, one may use Table B-1. Here the sample number, area condition number, description of the sample and the quantity measured are summarized. Additional measurement parameters will also be found tabulated in this table.

When looking at the data, one may observe discontinuities in the data at approximately 0.4 and 1.0 μm. This discontinuity occurs at the point where a change is made in detectors on the Beckman DK-II. This discontinuity is small and should not be viewed with great concern. It can be used as a measure of the instrument precision.

All of the data shown will be retained in the ERIM library and can be obtained on request, with approval of the sponsor, either in card or magnetic tape format.

TABLE B-1. SUMMARY OF ρ_d DATA CONTENTS

Description	Sample No.	Area No.	Reflectance ρ_d, or Emittance ϵ_d	Temperature (deg)	θ_r	θ_i	ϕ_r
3M Black Velvet Paint, 101-C10	1767	106	ϵ_d	318 K	0		0.0
Thermal Control Mirror TRW	3158	102	ϵ_d	13 C	30		0.0
Thermal Control Mirror TRW	3158	103	ϵ_d	13 C	45		0.0
Thermal Control Mirror TRW	3158	104	ϵ_d	13 C	10		0.0
Thermal Control Mirror TRW	3158	105	ϵ_d	100 C	[illegible]		0.0
Thermal Control Mirror TRW	3158	107	ϵ_d	100 C	45		0.0
TRW 2nd Surface Mirror Array	3165	204	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	304	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	404	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	504	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	604	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	704	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	804	ρ_d			5	
TRW 2nd Surface Mirror Array	3165	205	ρ_d			[illegible]	
Aluminum Trim Tape Array	3177	301	ρ_d			5	
Aluminum Trim Tape Array	3177	101	ρ_d			5	
Solar Cell Array, H-Type	3178	101	ρ_d			5	
Solar Cell Array, H-Type	3178	201	ρ_d			5	
Solar Cell Array, H-Type	3178	301	ρ_d			5	
Solar Cell Array, H-Type	3179	101	ρ_d			5	
Solar Cell Array, H-Type	3179	201	ρ_d			5	
Solar Cell Array, H-Type	3179	301	ρ_d			5	
Solar Cell Array, C-Type	3180	101	ρ_d			5	

TABLE B-1. SUMMARY OF ρ_d DATA CONTENTS (Continued)

Description	Sample No.	Area No.	Reflectance ρ_d, or Emittance ϵ_d	Temperature (deg)	θ_r	θ_i	ϕ_r
Solar Cell Array, C-Type	3180	201	ρ_d				5
Solar Cell Array, C-Type	3180	301	ρ_d				5
Solar Cell Array, C-Type	3181	101	ρ_d				5
Solar Cell Array, C-Type	3181	201	ρ_d				5
Solar Cell Array, C-Type	3181	301	ρ_d				5
Solar Cell Array, H-Type	3182	101	ρ_d				5
Solar Cell Array, H-Type	318[illegible]	201	ρ_d				5
Solar Cell Array, H-Type	3182	301	ρ_d				5
Solar Cell Array, H-Type	3183	101	ρ_d				5
Solar Cell Array, H-Type	3183	201	ρ_d				5
Solar Cell Array, H-Type	3183	301	ρ_d				5
Solar Cell Array, C-Type	3184	101	ρ_d				5
Solar Cell Array, C-Type	3184	201	ρ_d				5
Solar Cell Array, C-Type	3184	301	ρ_d				5
Solar Cell Array, C-Type	3185	101	ρ_d				5
Solar Cell Array, C-Type	3185	[illegible]	[illegible]				5
Solar Cell Array, C-Type	3185	[illegible]					5
Solar Cell Array, H-Type	3186	101					5
Solar Cell Array, H-Type	3186	201	ρ_d				5
Solar Cell Array, H-Type	3186	301	ρ_d				5
Solar Cell Array C-Type	3187	101	ρ_d				5
Solar Cell Array C-Type	3187	201	ρ_d				5
Solar Cell Array C-Type	3187	301	ρ_d				5
Aerojet 2nd Surface Mirror Array	3190	101	ρ_d				5
Aerojet 2nd Surface Mirror Array	3190	201	ρ_d				5

TABLE B-1. SUMMARY OF ρ_d DATA CONTENTS (Continued)

Description	Sample No.	Area No.	Reflectance ρ_d, or Emittance ϵ_d	Temperature (deg)	θ_r	θ_i	ϕ_r
Aerojet 2nd Surface Mirror Array	3190	301	ρ_d				5
Aerojet 2nd Surface Mirror Array	3192	101	ρ_d				5
Aerojet 2nd Surface Mirror Array	3192	201	ρ_d				5
Aerojet 2nd Surface Mirror Array	3192	301	ρ_d				5
Aerojet 2nd Surface Mirror Array	3194	101	ρ_d				5
Aerojet 2nd Surface Mirror Array	3194	201	ρ_d				5
Aerojet 2nd Surface Mirror Array	3194	301	ρ_d				5
3M Black Velvet Paint, 101-C10	3197	101	ρ_d				5
3M Black Velvet Paint, 101-C10	3197	201	ρ_d				5
3M Black Velvet Paint, 101-C10	3198	101	ρ_d				5
3M Black Velvet Paint, 101-C10	3198	201	ρ_d				5
Aerojet 2nd Surface Mirror Array	3200	101	ρ_d				5
Aerojet 2nd Surface Mirror Array	3200	201	ρ_d				5
Aerojet 2nd Surface Mirror Array	3200	301	ρ_d				5
Aerojet White Paint .008"-.010" Thick Telescope Substrate	3206	101	ρ_d				5
Aerojet White Paint .008"-.010" Thick Telescope Substrate	3206	201	ρ_d				5
Aerojet White Paint .008"-.010" Thick Telescope Substrate	3207	101	ρ_d				5
Aerojet White Paint .008"-.010" Thick Telescope Substrate	3207	201	ρ_d				5
Aerojet White Paint Star Sensor Substrate	3209	101	ρ_d				5
Aerojet White Paint Star Sensor Substrate	3209	201	ρ_d				5
3M Black Velvet Paint, 401-C10	3212	101	ϵ_d	300 K	0		0.0

TABLE B-1. SUMMARY OF ρ_d DATA CONTENTS (Continued)

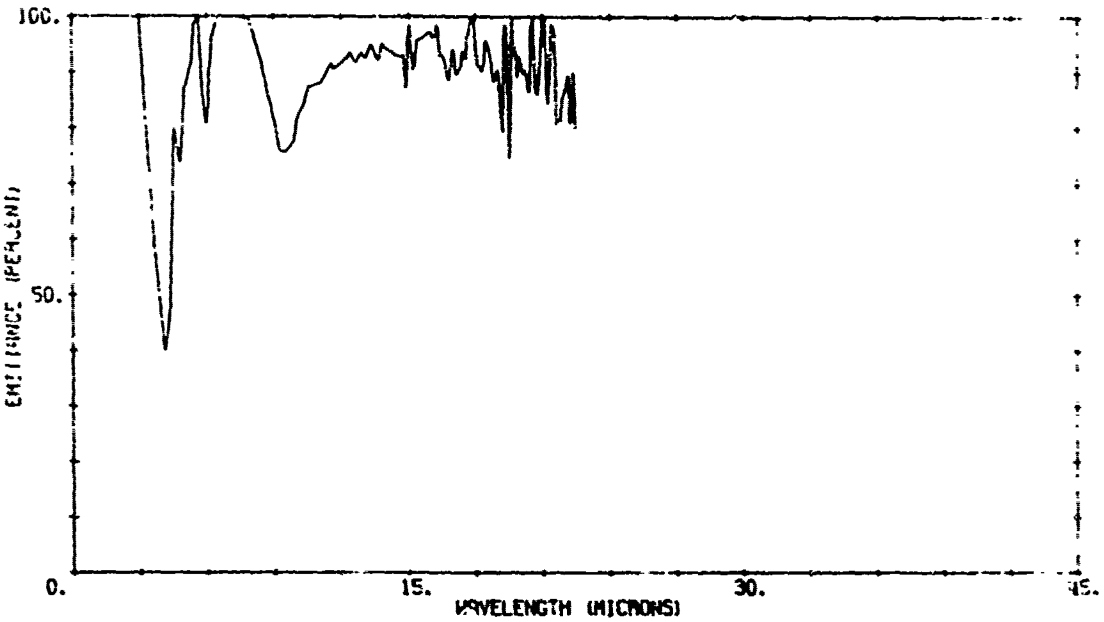
Description	Sample No.	Area No.	Reflectance ρ_d, or Emittance ϵ_d	Temperature (deg)	θ_r	θ_i	ϕ_r
3M Black Velvet Paint, 401-C10	3212	102	ϵ_d	300 K	80		0.0
3M Black Velvet Paint, 401-C10	3212	103	ϵ_d	300 K	75		0.0
3M Black Velvet Paint, 401-C10	3212	104	ϵ_d	300 K	70		0.0
3M Black Velvet Paint, 401-C10	3212	105	ϵ_d	300 K	0		0.0
3M Black Velvet Paint, 401-C10	3212	106	ϵ_d	300 K	45		0.0
Aerojet 2nd Surface Mirror Array	3213	101	ϵ_d	200 K	0		0.0
Aerojet 2nd Surface Mirror Array	3213	102	ϵ_d	200 K	10		0.0
Aerojet 2nd Surface Mirror Array	3213	103	ϵ_d	200 K	20		0.0
Aerojet 2nd Surface Mirror Array	3213	104	ϵ_d	200 K	30		0.0
Aerojet 2nd Surface Mirror Array	3213	105	ϵ_d	200 K	40		0.0
Aerojet 2nd Surface Mirror Array	3213	106	ϵ_d	200 K	50		0.0
Aerojet 2nd Surface Mirror Array	3213	107	ϵ_d	200 K	60		0.0
Aerojet 2nd Surface Mirror Array	3213	108	ϵ_d	200 K	70		0.0
Aerojet 2nd Surface Mirror Array	3213	109	ϵ_d	200 K	80		0.0
Aerojet 2nd Surface Mirror Array	3213	201	ϵ_d	373 K	0		0.0
Aerojet 2nd Surface Mirror Array	3213	202	ϵ_d	373 K	10		0.0
Aerojet 2nd Surface Mirror Array	3213	203	ϵ_d	373 K	20		0.0
Aerojet 2nd Surface Mirror Array	3213	204	ϵ_d	373 K	30		0.0
Aerojet 2nd Surface Mirror Array	3213	205	ϵ_d	373 K	40		0.0
Aerojet 2nd Surface Mirror Array	3213	206	ϵ_d	373 K	50		0.0
Aerojet 2nd Surface Mirror Array	3213	207	ϵ_d	373 K	60		0.0
Aerojet 2nd Surface Mirror Array	3213	208	ϵ_d	373 K	70		0.0
Aerojet 2nd Surface Mirror Array	3213	209	ϵ_d	373 K	80		0.0
Aerojet Solar Cell	3214	101	ϵ_d	200 K	0		0.0

TABLE B-1. SUMMARY OF ρ_d DATA CONTENTS (Concluded)

Description	Sample No.	Area No.	Reflectance ρ_d, or Emittance ϵ_d	Temperature (deg)	θ_r	θ_i	ϕ_r
Aerojet Solar Cell	3214	102	ε_d	200 K	10		0.0
Aerojet Solar Cell	3214	103	ε_d	200 K	20		0.0
Aerojet Solar Cell	3214	104	ε_d	200 K	30		0.0
Aerojet Solar Cell	3214	105	ε_d	200 K	40		0.0
Aerojet Solar Cell	3214	106	ε_d	200 K	50		0.0
Aerojet Solar Cell	3214	107	ε_d	200 K	60		0.0
Aerojet Solar Cell	3214	108	ε_d	200 K	70		0.0
Aerojet Solar Cell	3214	109	ε_d	200 K	80		0.0
Aerojet Solar Cell	3214	201	ε_d	373 K	0		0.0
Aerojet Solar Cell	3214	202	ε_d	373 K	10		0.0
Aerojet Solar Cell	3214	203	ε_d	373 K	20		0.0
Aerojet Solar Cell	3214	204	ε_d	373 K	30		0.0
Aerojet Solar Cell	3214	205	ε_d	373 K	40		0.0
Aerojet Solar Cell	3214	206	ε_d	373 K	50		0.0
Aerojet Solar Cell	3214	207	ε_d	373 K	60		0.0
Aerojet Solar Cell	3214	208	ε_d	373 K	70		0.0
Aerojet Solar Cell	3214	209	ε_d	373 K	80		0.0
White Paint, DC 92-007	3215	101	ρ_d			15	
White Paint, DC S-13G	3216	101	ρ_d			15	

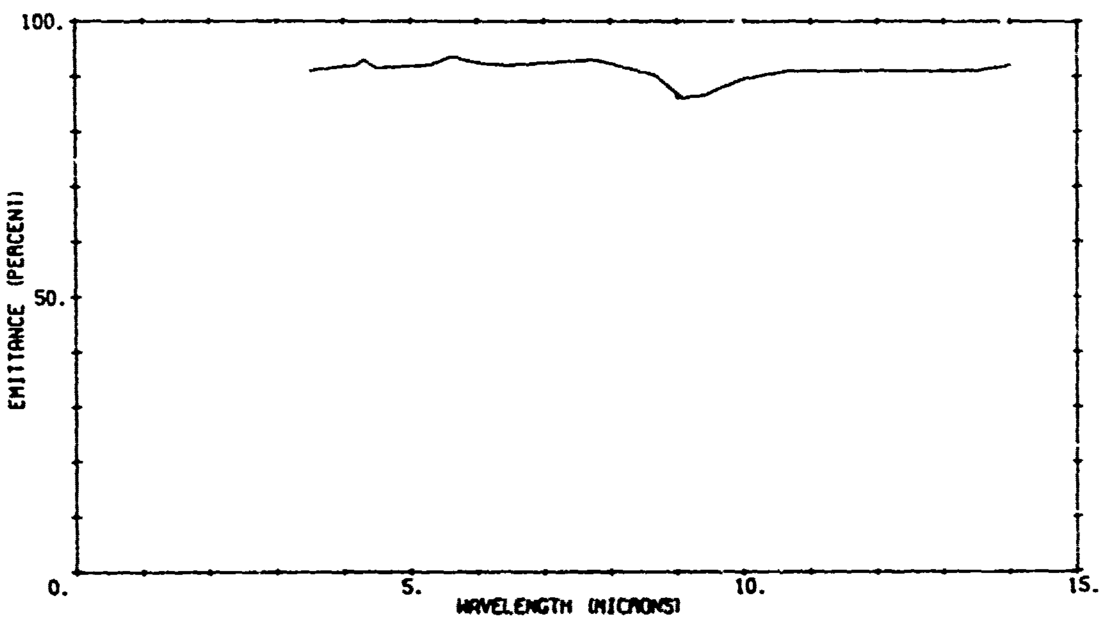
A03158 102 THERMAL CONTROL MIRROR, TRW

θ_r 30° T · 13C



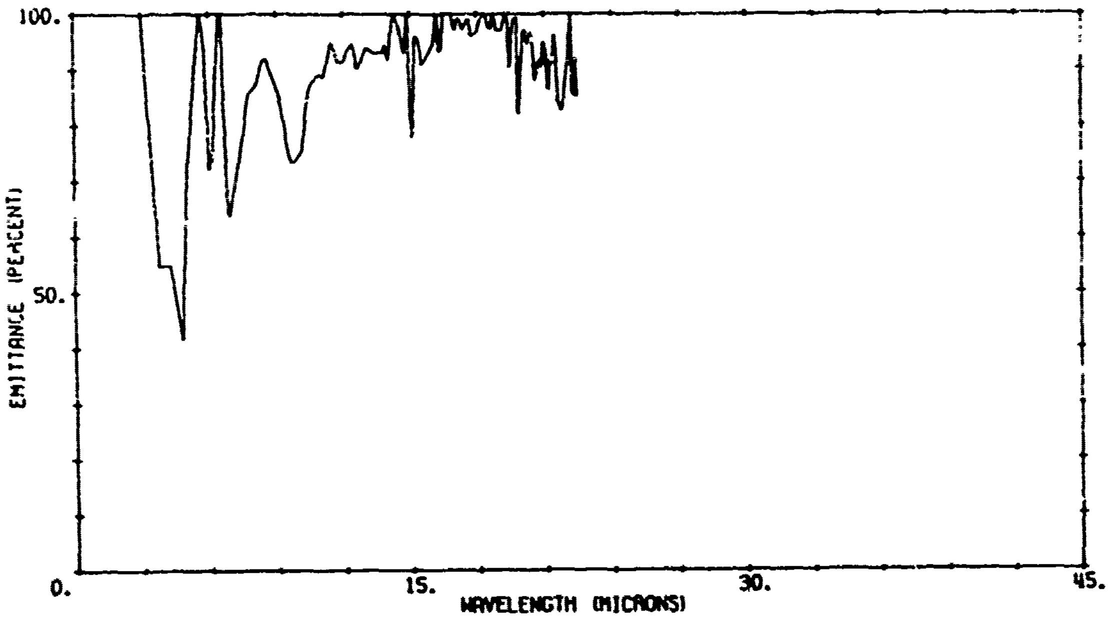
A01767 106 3M BLACK VELVET PAINT, 101-C10

θ_r = 0.0° T = 318°K



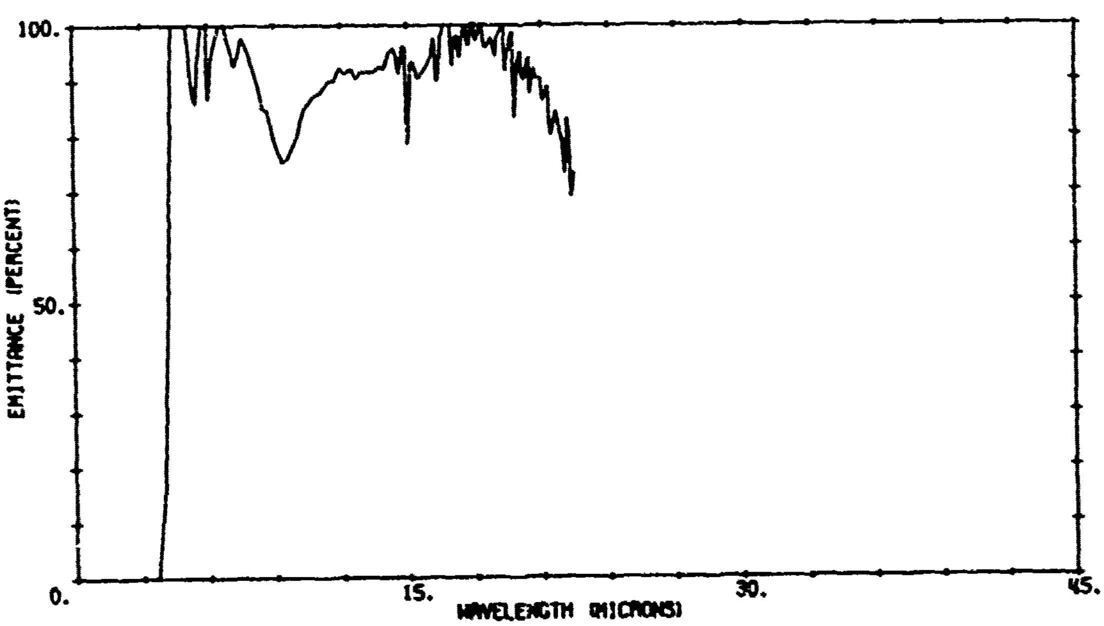
A03158 104

THERMAL CONTROL MIRROR, TRW
θ_r 10° T = 13C



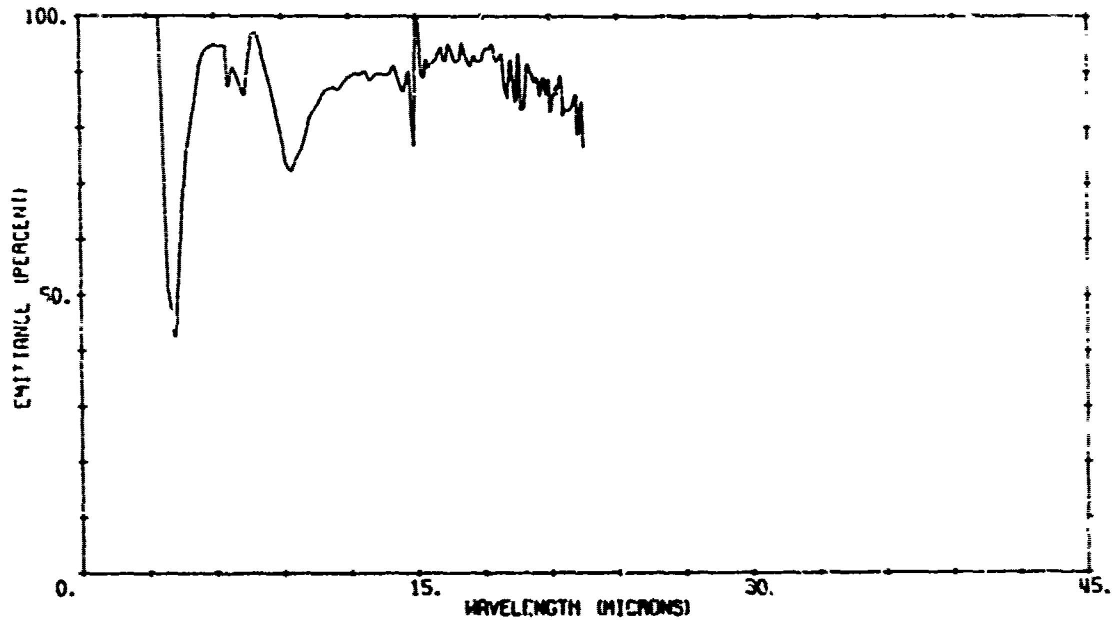
A03158 103

THERMAL CONTROL MIRROR, TRW
θ_r = 45° T = 13C



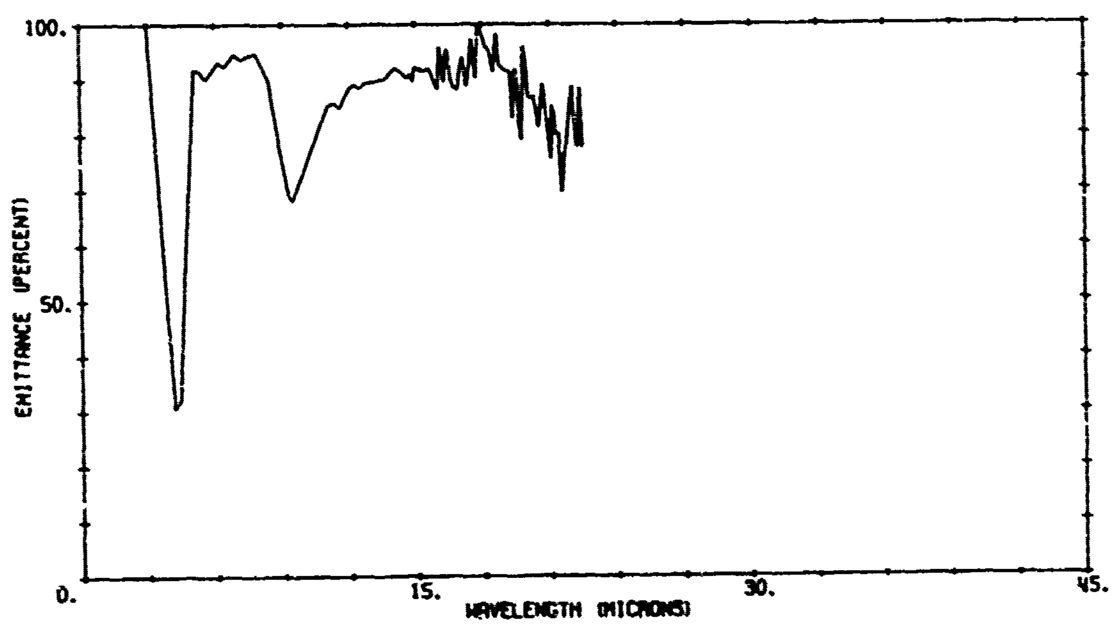
A03158 107 THERMAL CONTROL MIRROR, TRW

θ_r 45° T 100C

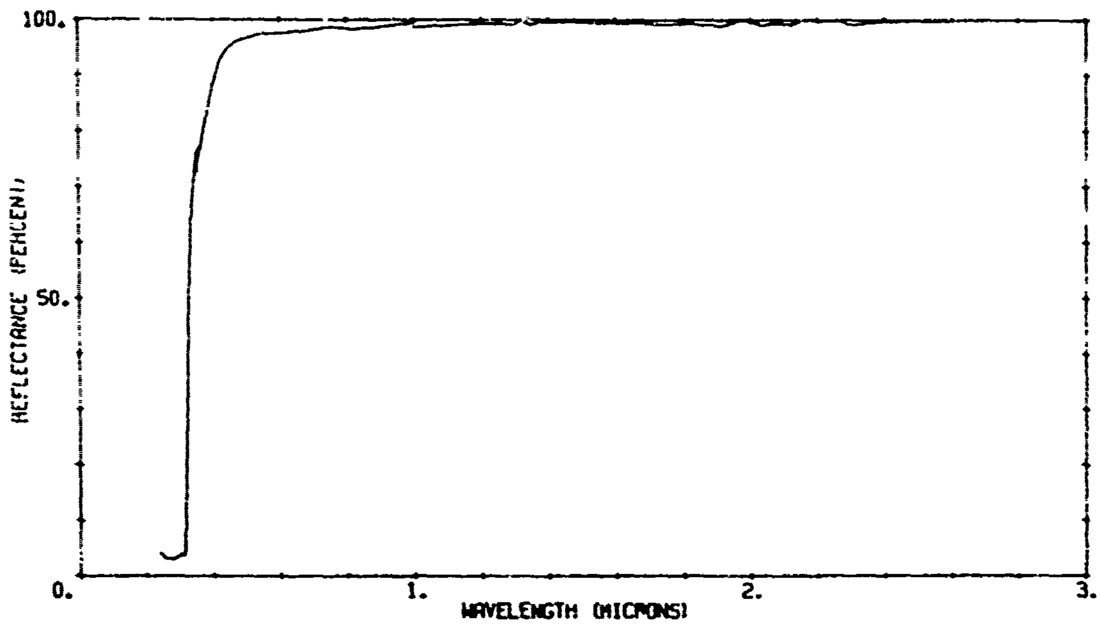


A03158 106 THERMAL CONTROL MIRROR, TRW

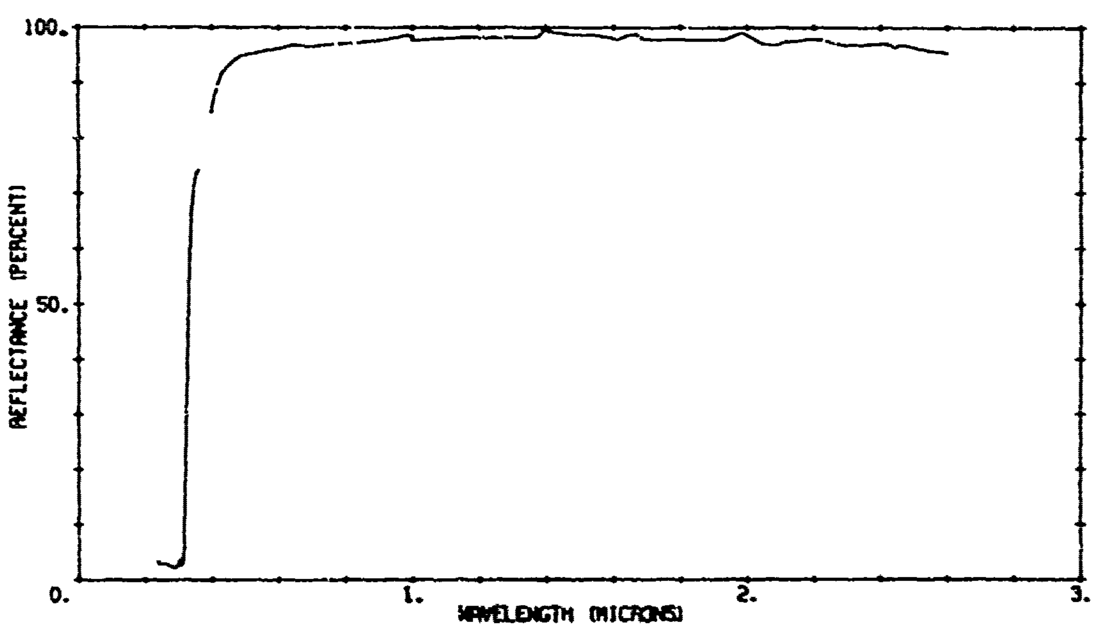
θ_r = 10° T = 100 C



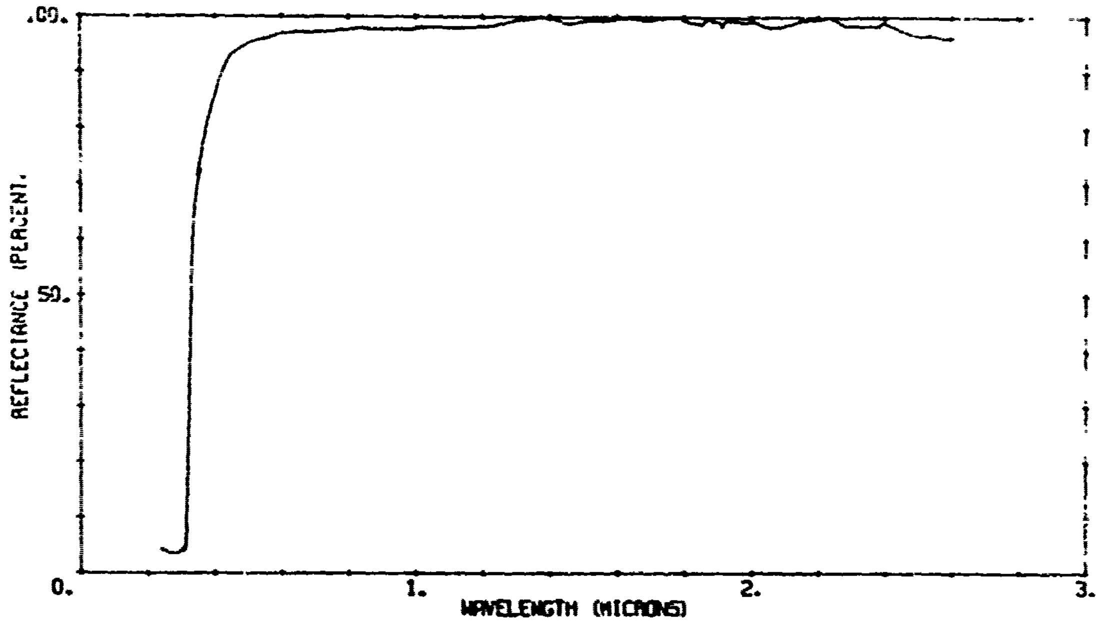
A03165 304 TRW SECOND SURFACE MIRROR ARRAY



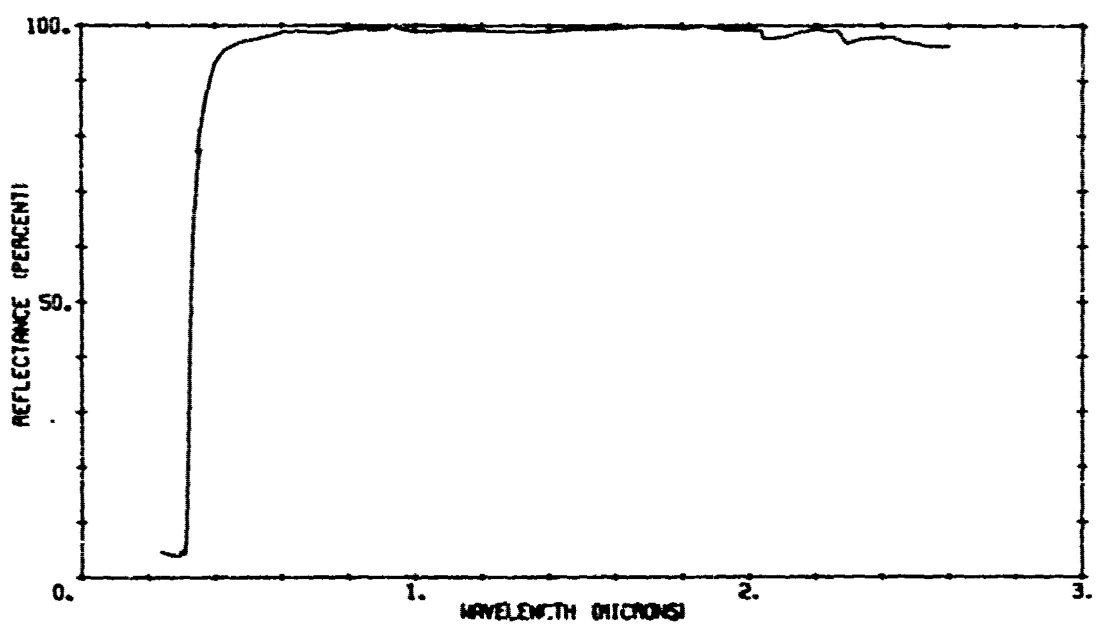
A03165 204 TRW SECOND SURFACE MIRROR ARRAY



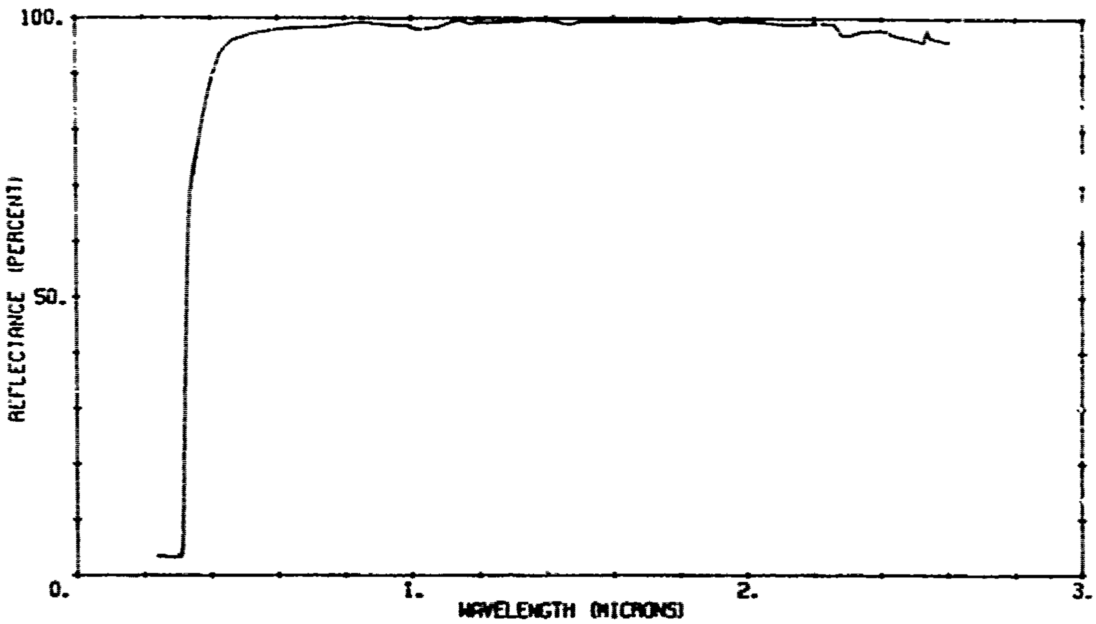
A03165 504 TRW SECOND SURFACE MIRROR ARRAY



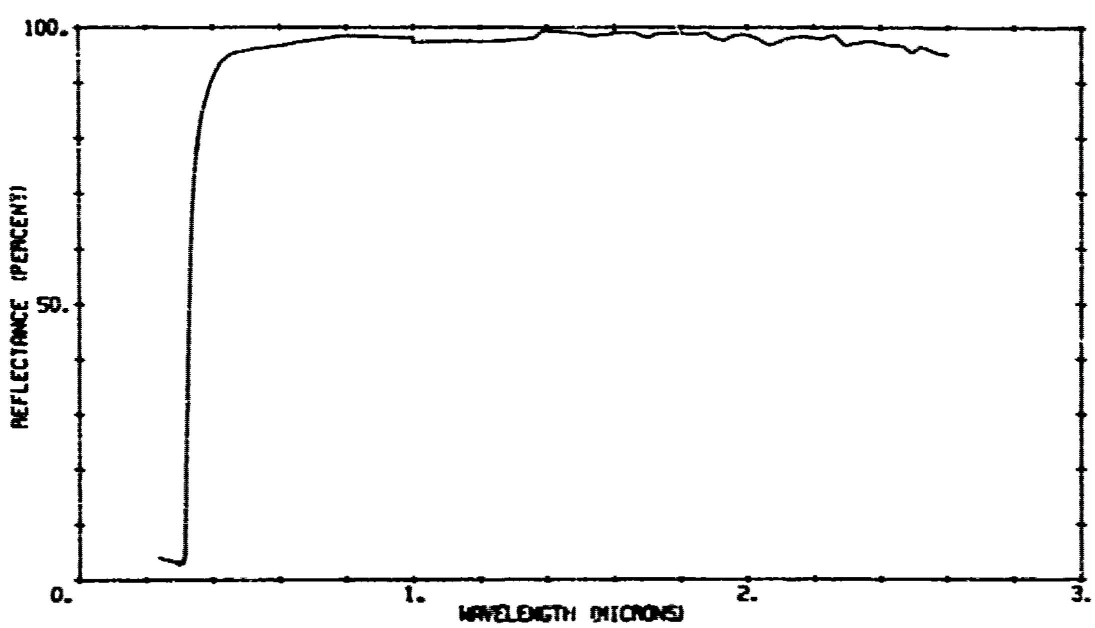
A03165 404 TRW SECOND SURFACE MIRROR ARRAY



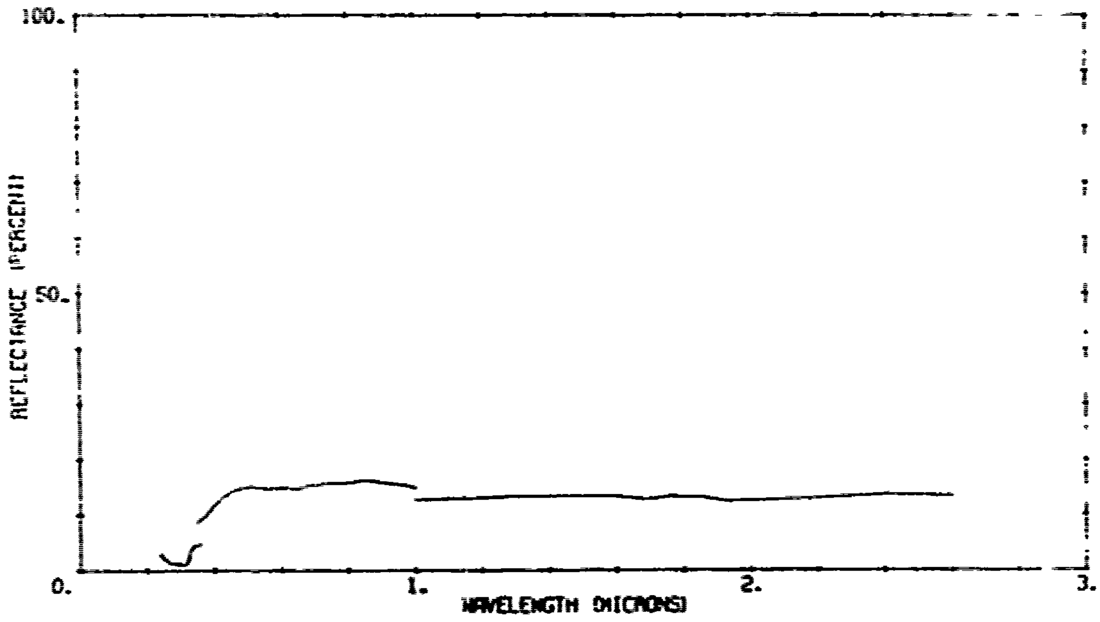
A03165 704 TRW SECOND SURFACE MIRROR ARRAY



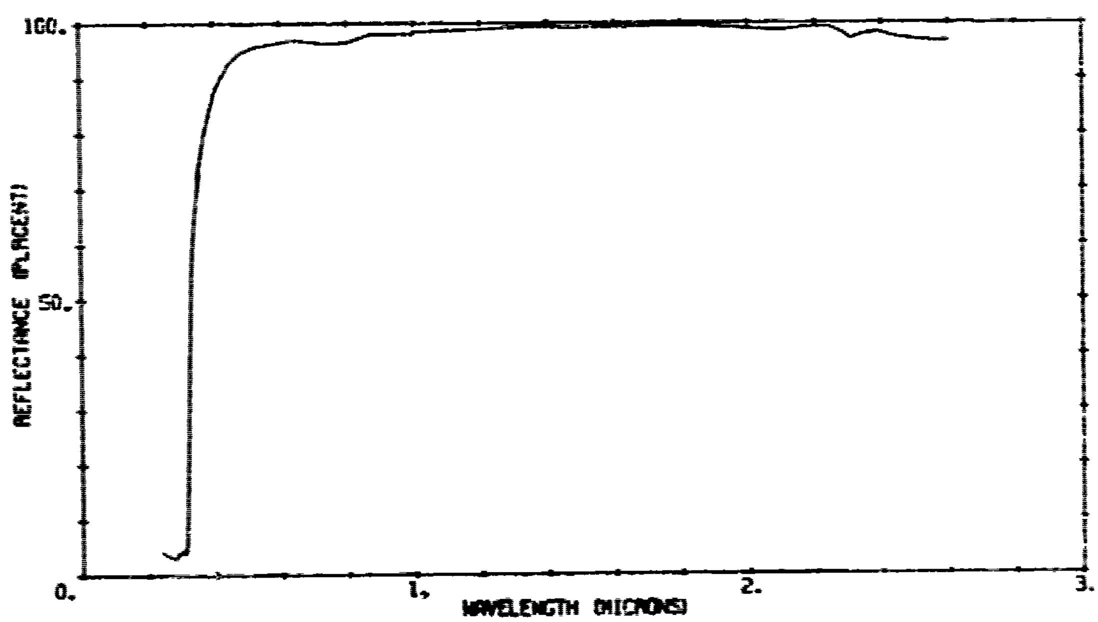
A03165 604 TRW SECOND SURFACE MIRROR ARRAY



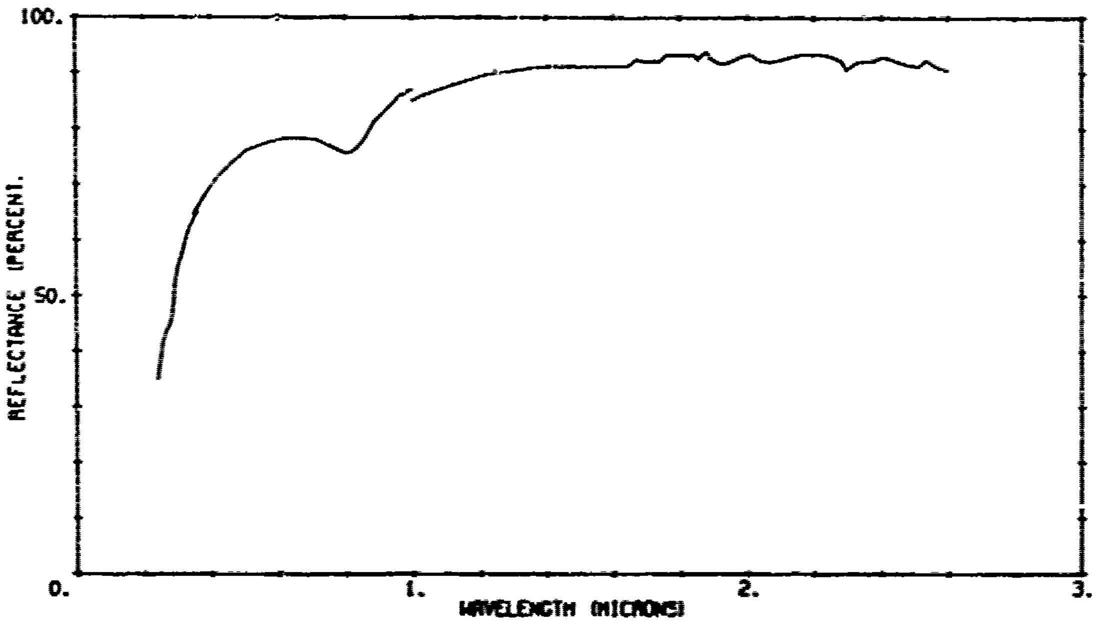
A03165 205 TRW SECOND SURFACE MIRROR ARRAY
θ_i - 0° SPECULAR EXCLUDED



A03165 804 TRW SECOND SURFACE MIRROR ARRAY

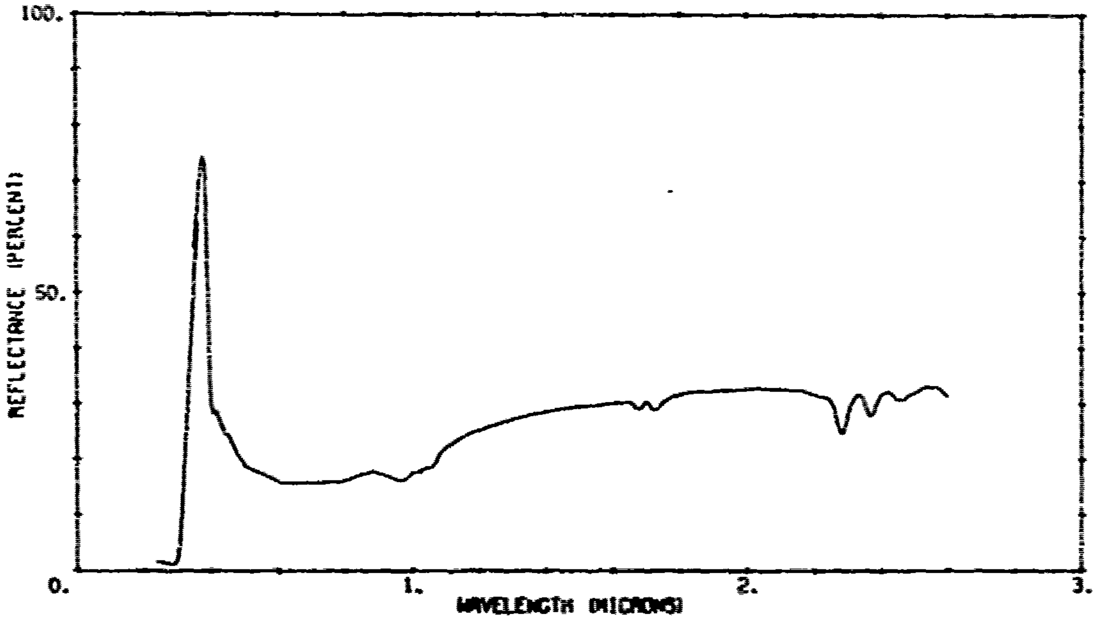


A03177 101 ALUMINUM TRIM TAPE STRIPE

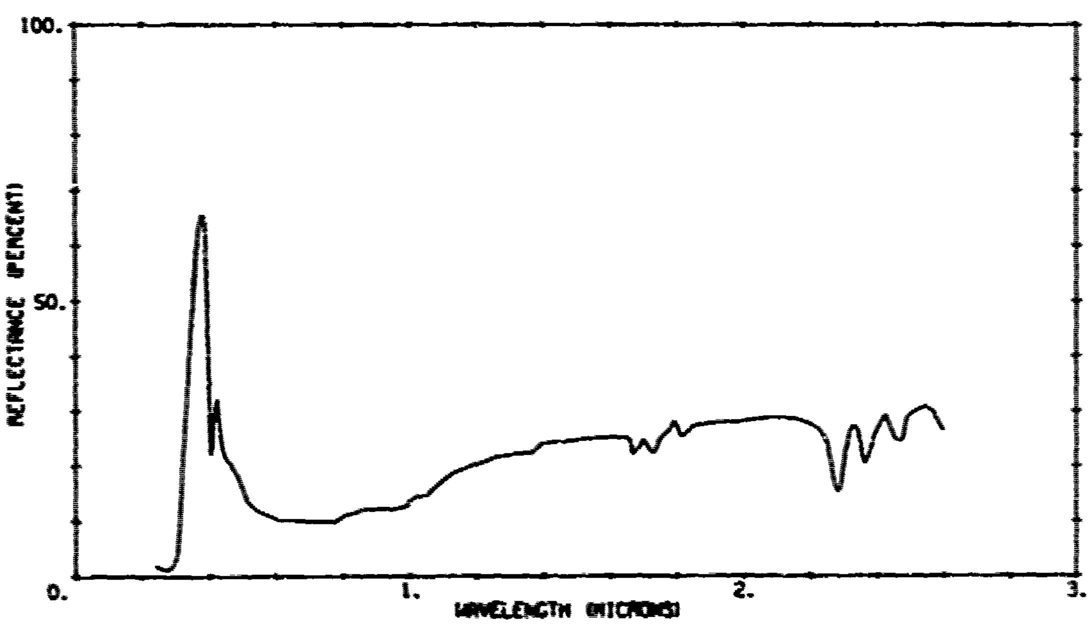


A03177 301 ALUMINUM TRIM TAPE STRIPS

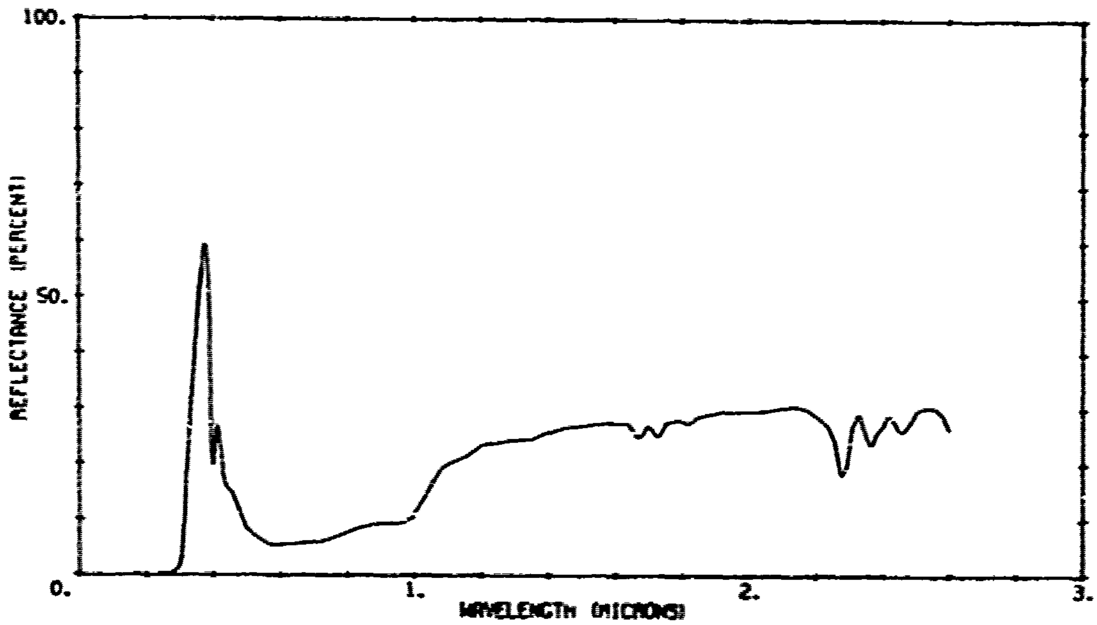
A03178 201 SOLAR CELL ARRAY, H-TYPE



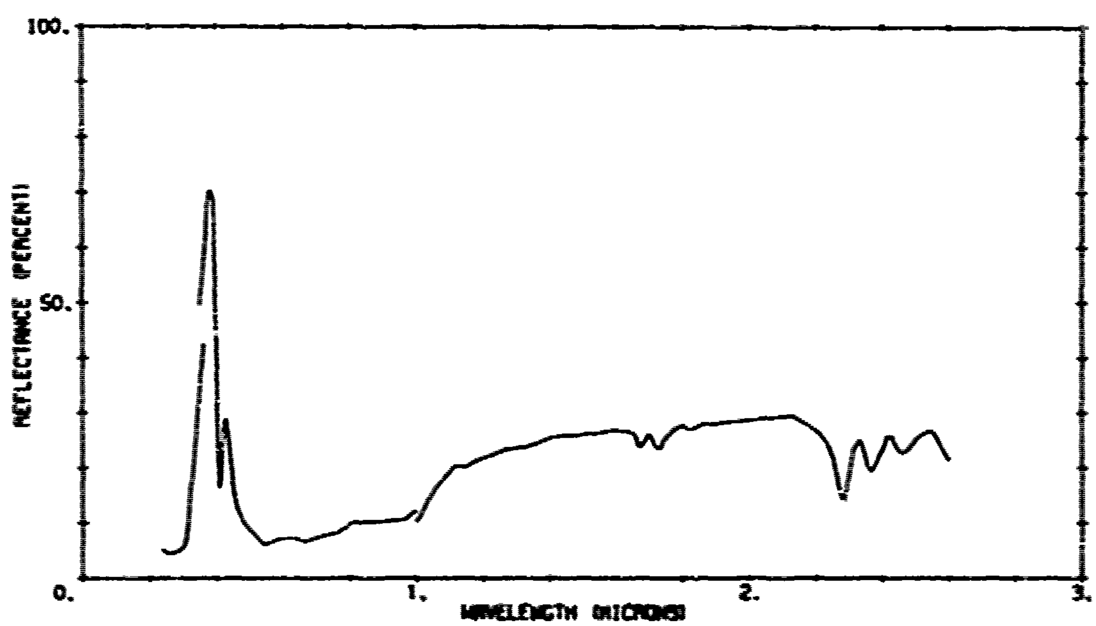
A03178 101 SOLAR CELL ARRAY, H-TYPE



A03179 101 SOLAR CELL ARRAY, H-TYPE

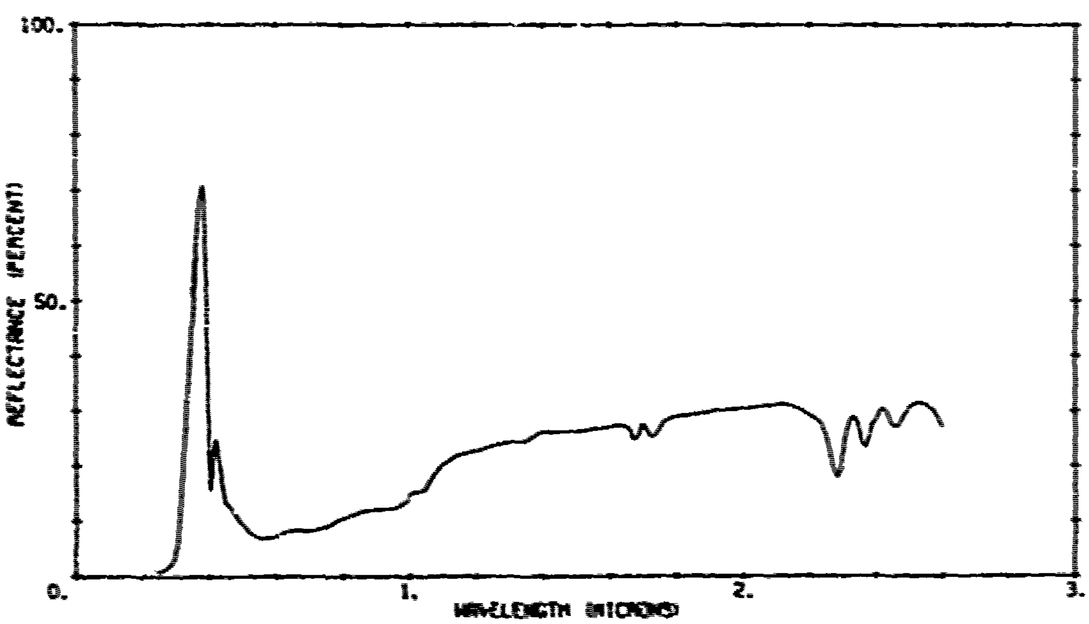


A03178 301 SOLAR CELL ARRAY, H-TYPE

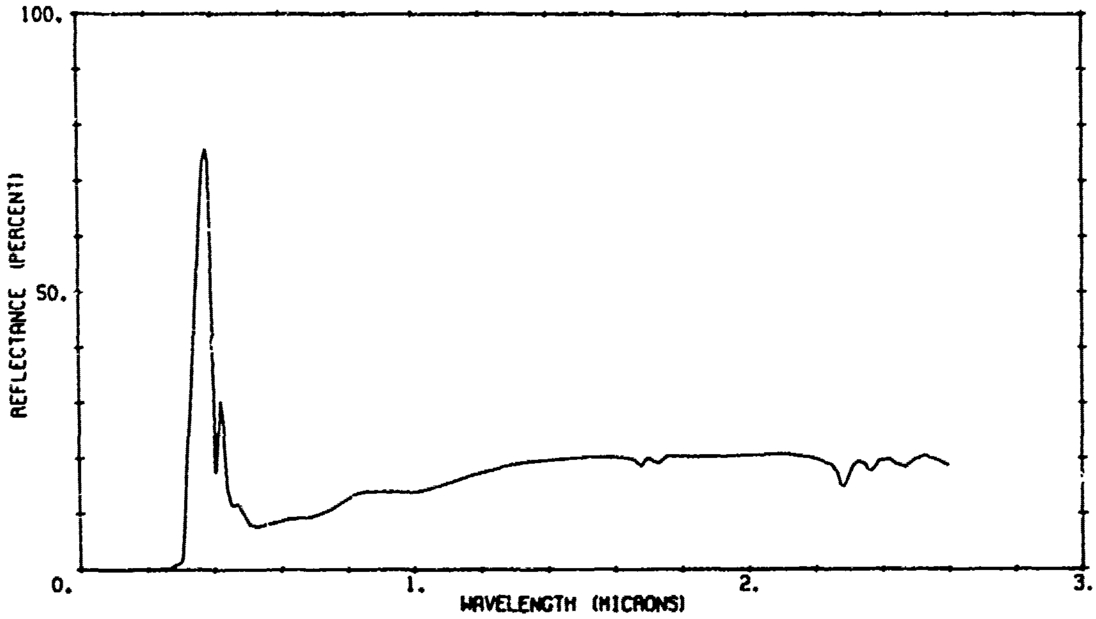


A03179 301 SOLAR CELL ARRAY, H-TYPE

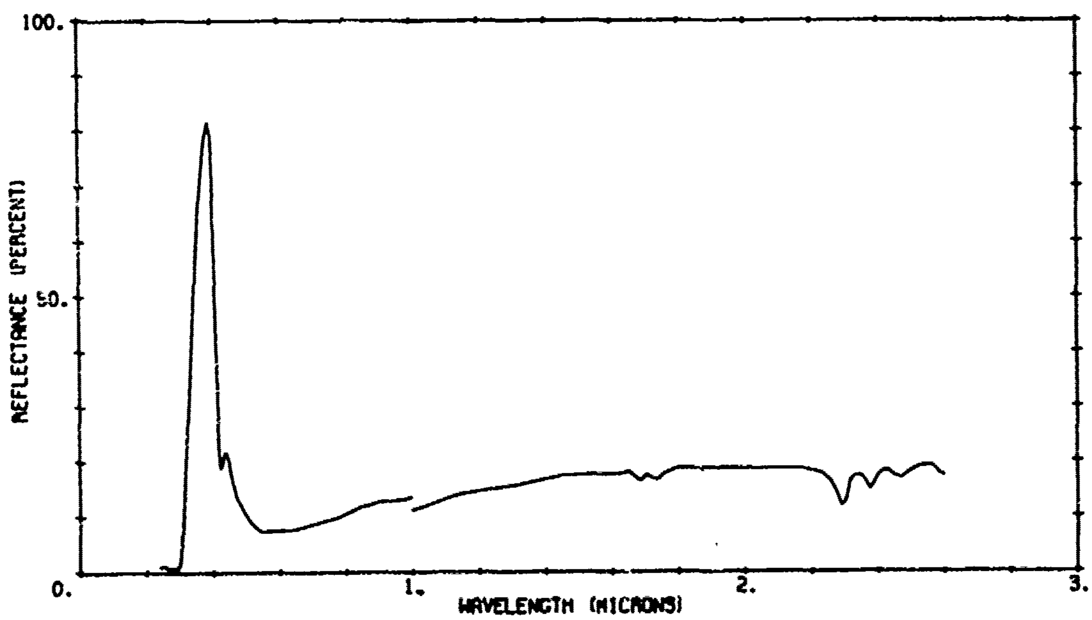
A03179 201 SOLAR CELL ARRAY, H-TYPE



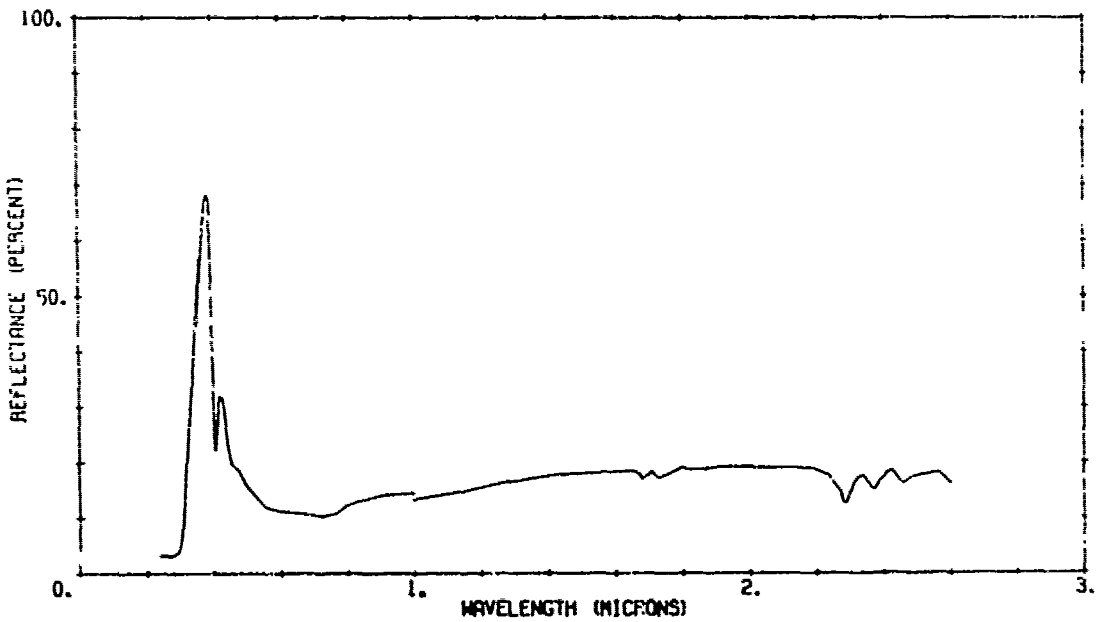
A03180 201 SOLAR CELL ARRAY, C-TYPE



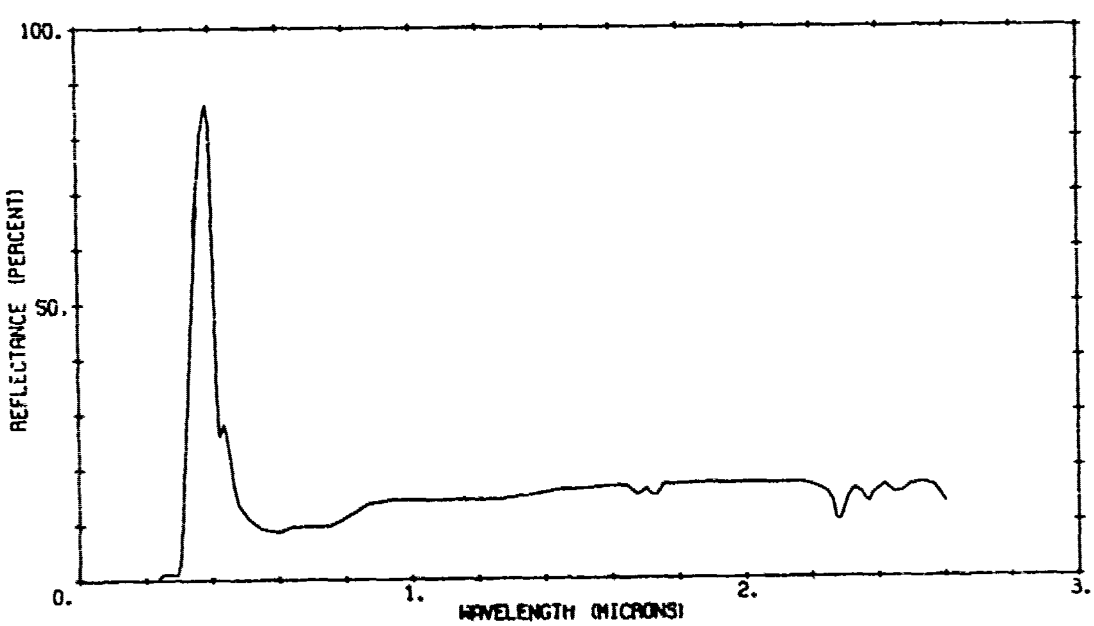
A03180 101 SOLAR CELL ARRAY, C-TYPE



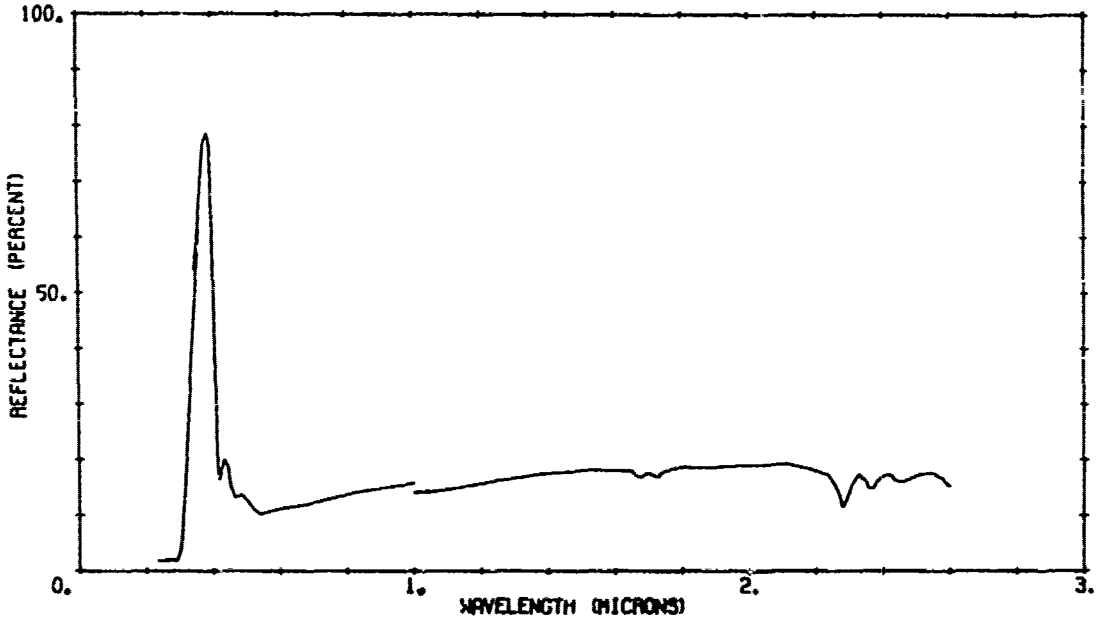
A03181 101 SOLAR CELL ARRAY, C-TYPE



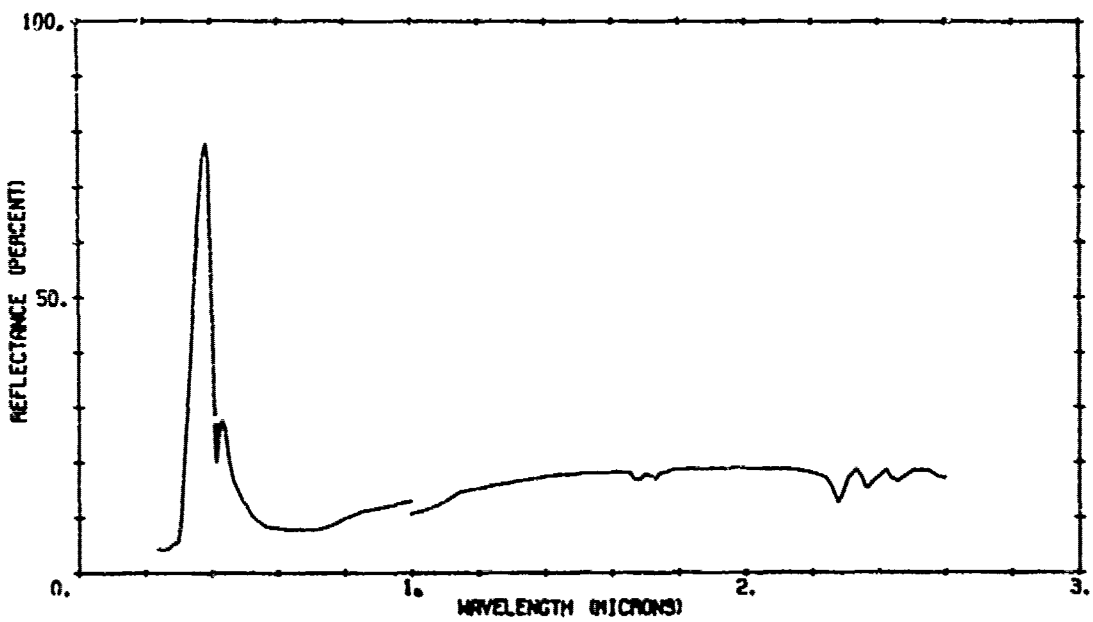
A03180 301 SOLAR CELL ARRAY, C-TYPE



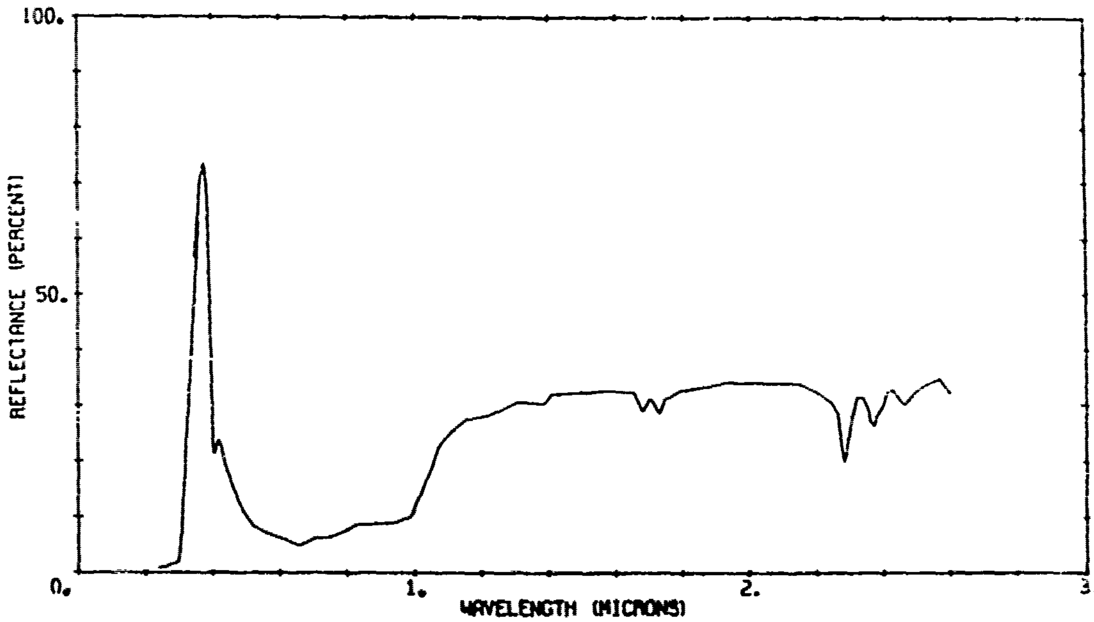
A03181 301 SOLAR CELL ARRAY, C-TYPE



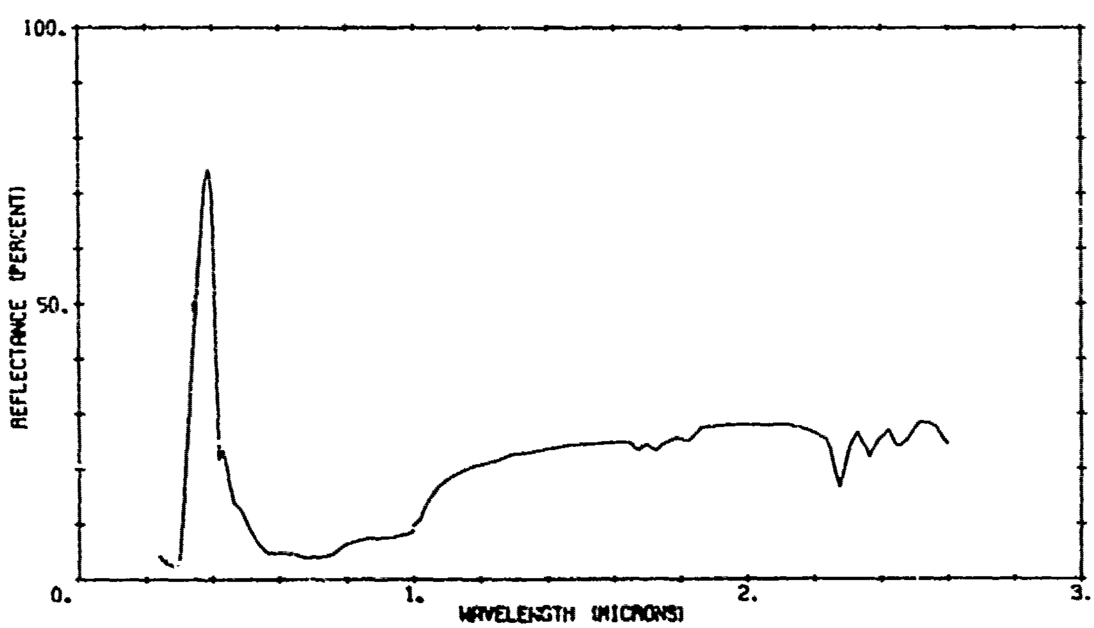
A03181 201 SOLAR CELL ARRAY, C-TYPE



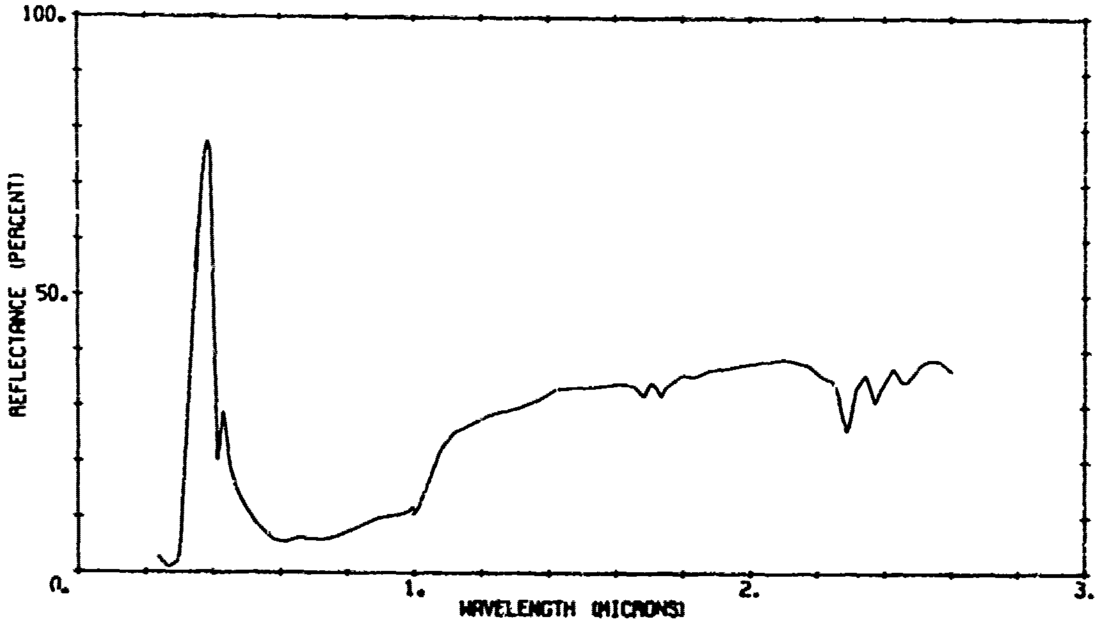
A03182 201 SOLAR CELL ARRAY, H-TYPE



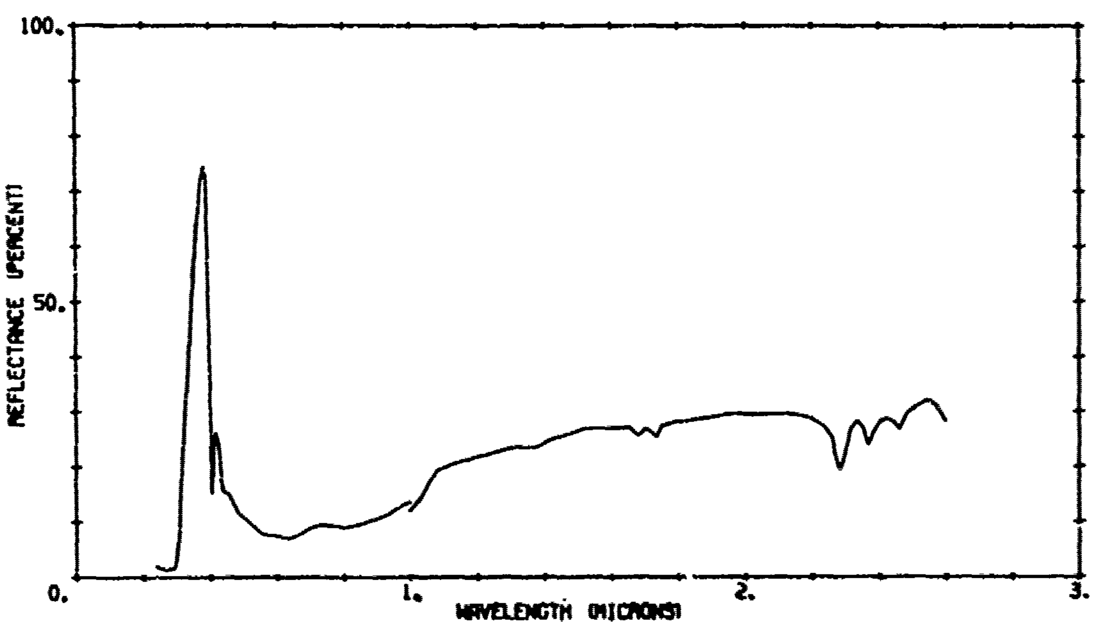
A03182 101 SOLAR CELL ARRAY, H-TYPE



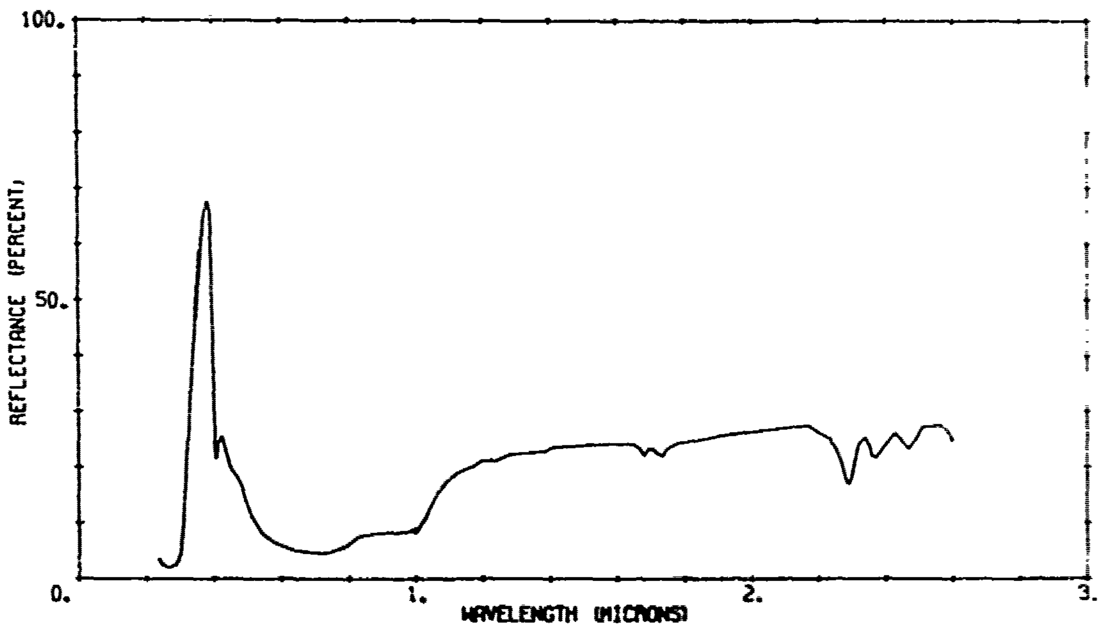
A03183 101 SOLAR CELL ARRAY, h TYPE



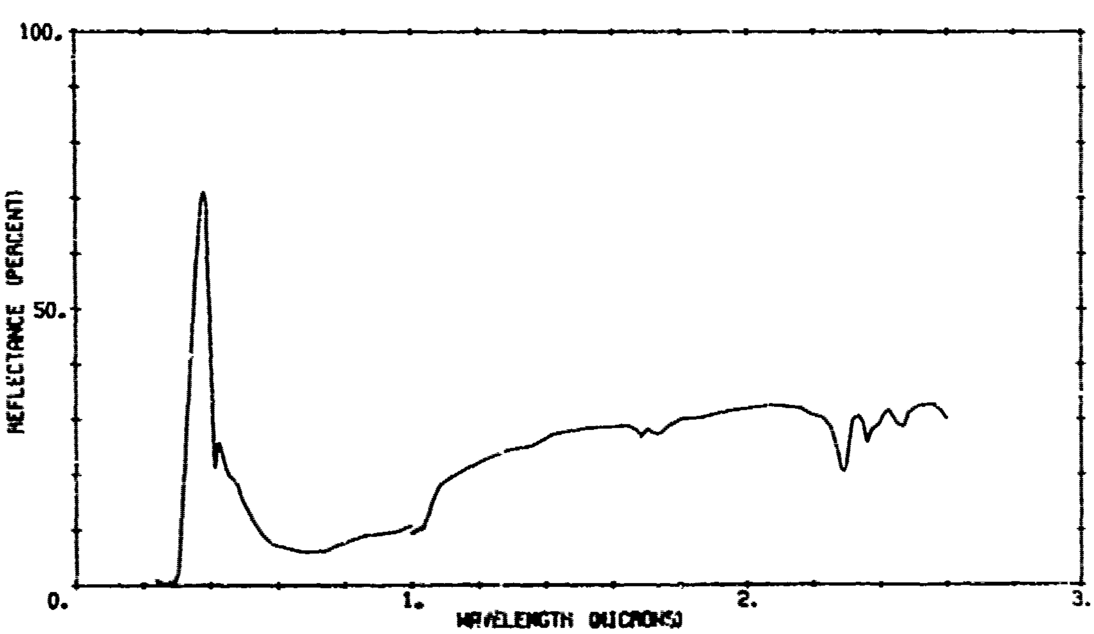
A03182 301 SOLAR CELL ARRAY, H-TYPE



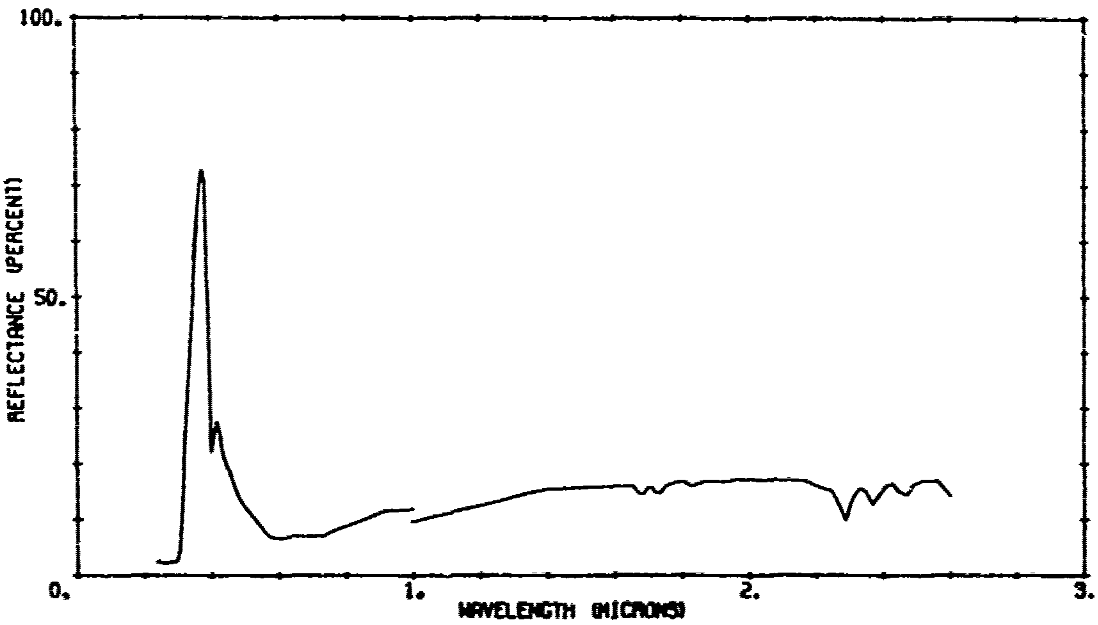
A03183 301 SOLAR CELL ARRAY, H-TYPE



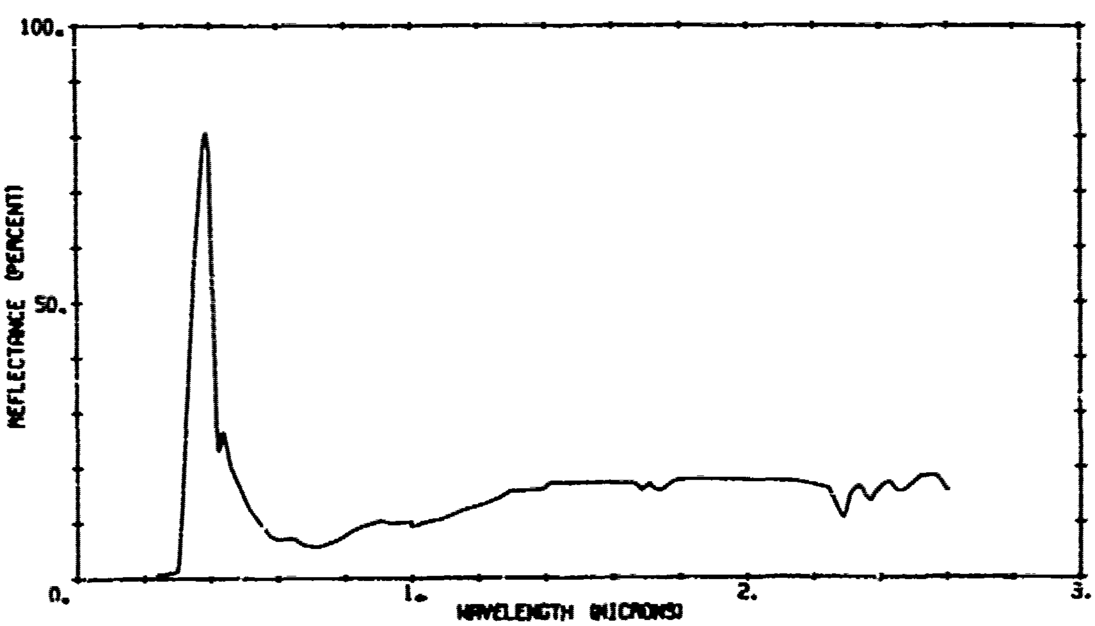
A03183 201 SOLAR CELL ARRAY, H-TYPE



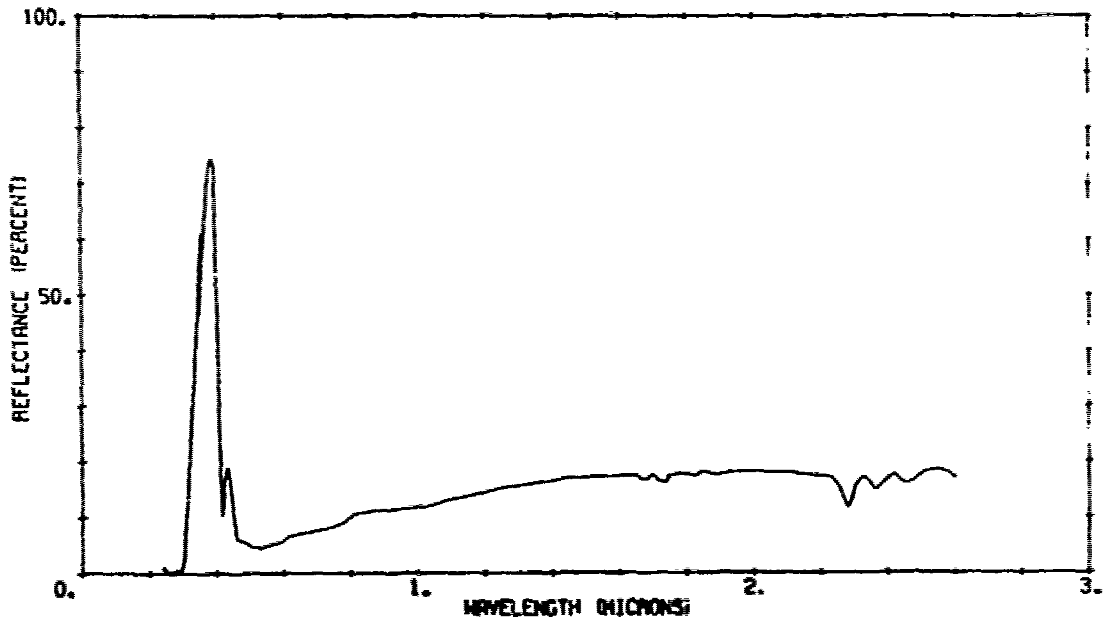
A03184 201 SOLAR CELL ARRAY, C-TYPE



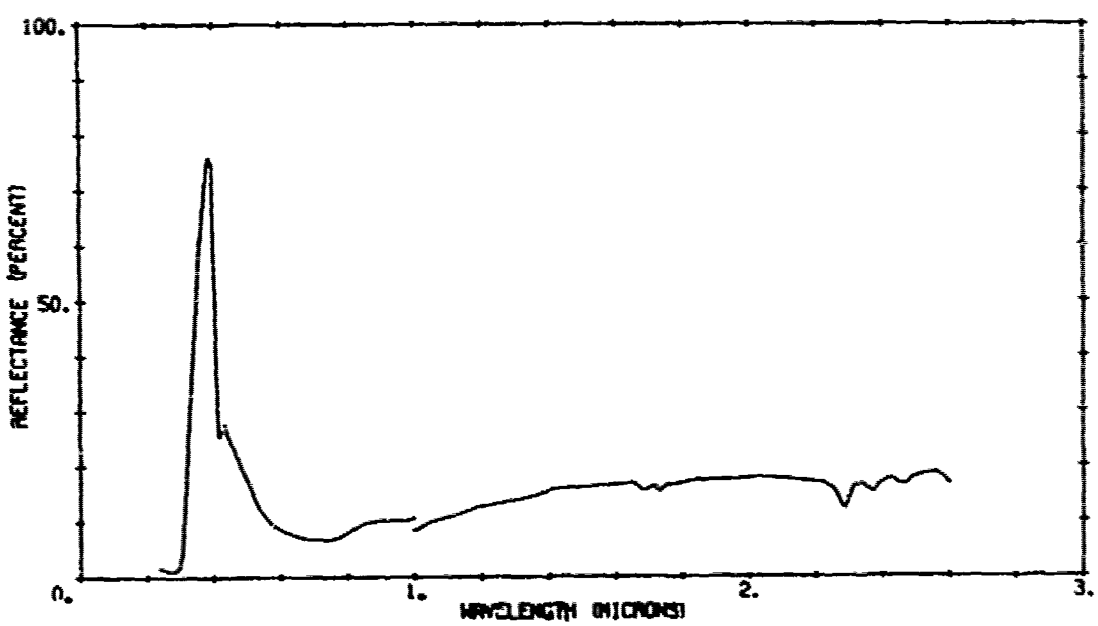
A03184 101 SOLAR CELL ARRAY, C-TYPE



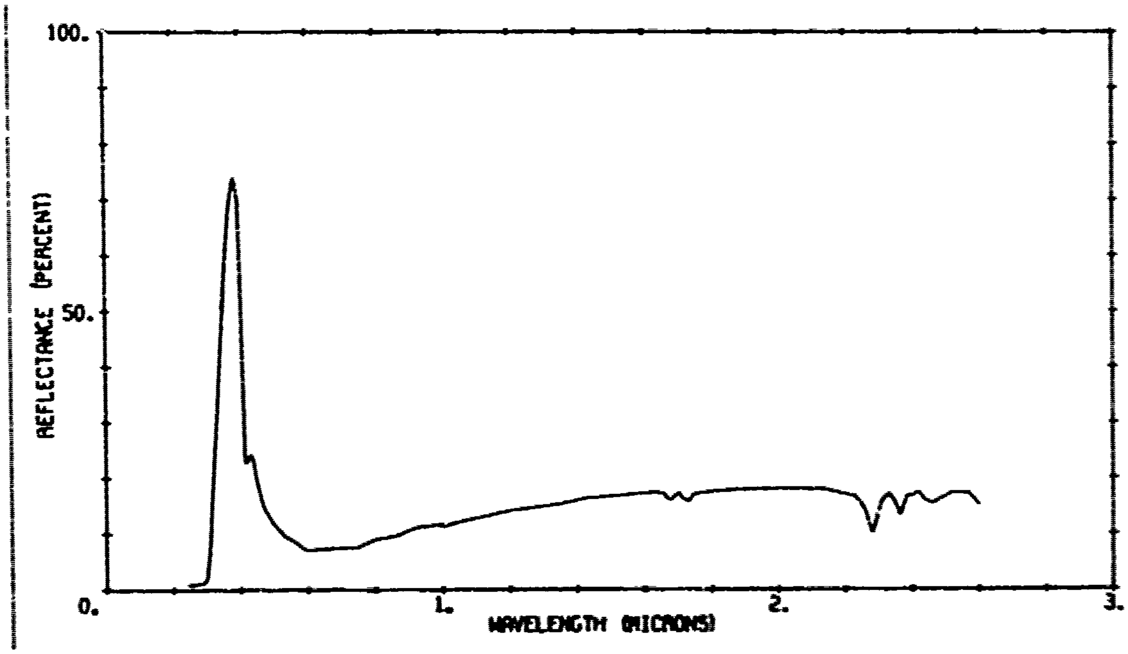
A03185 101 SOLAR CELL ARRAY, C-TYPE



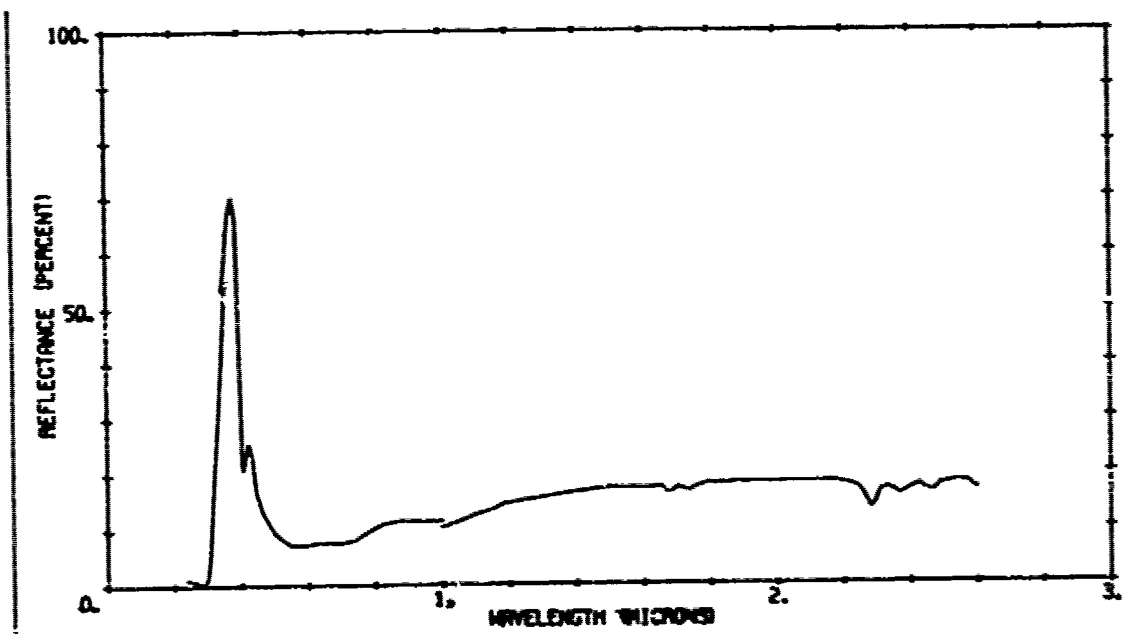
A03184 301 SOLAR CELL ARRAY, C-TYPE



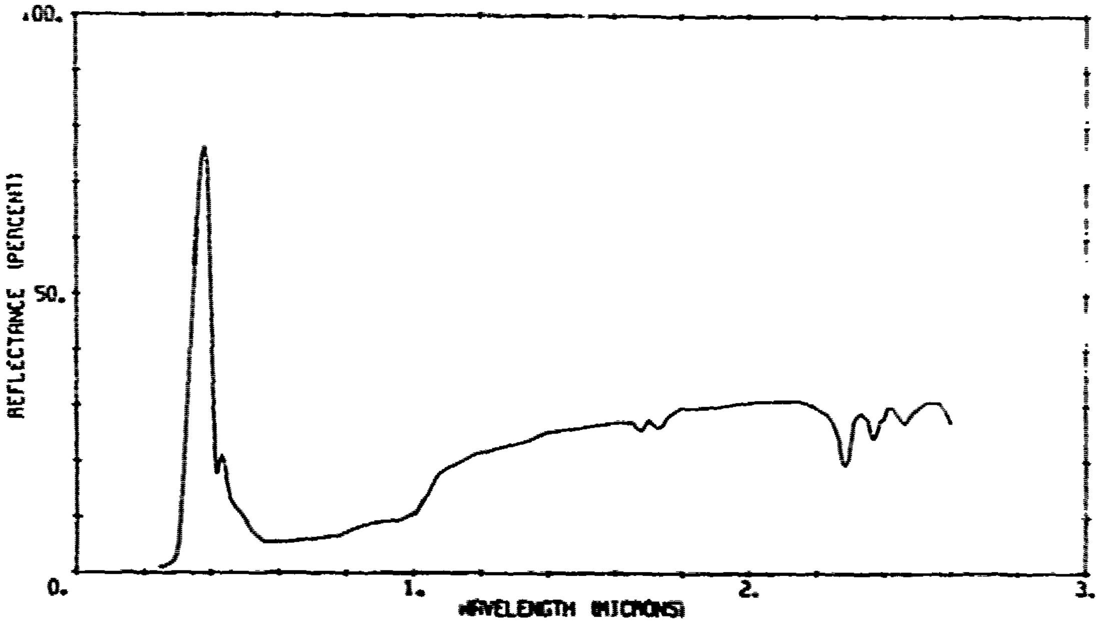
A03185 301 SOLAR CELL ARRAY, C-TYPE



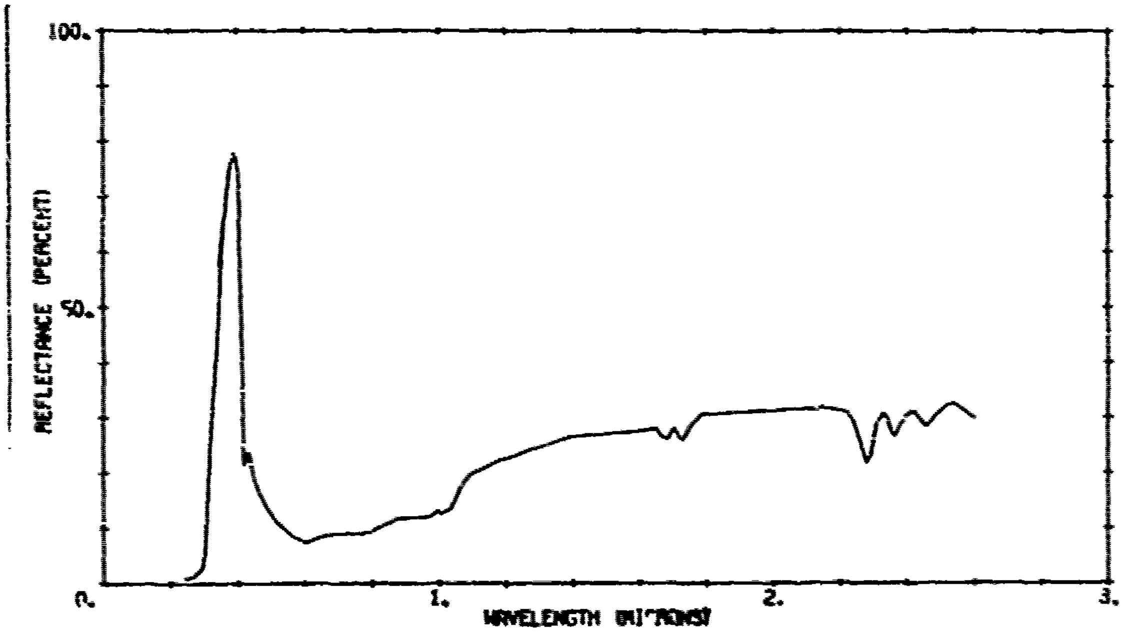
A03185 201 SOLAR CELL ARRAY, C-TYPE



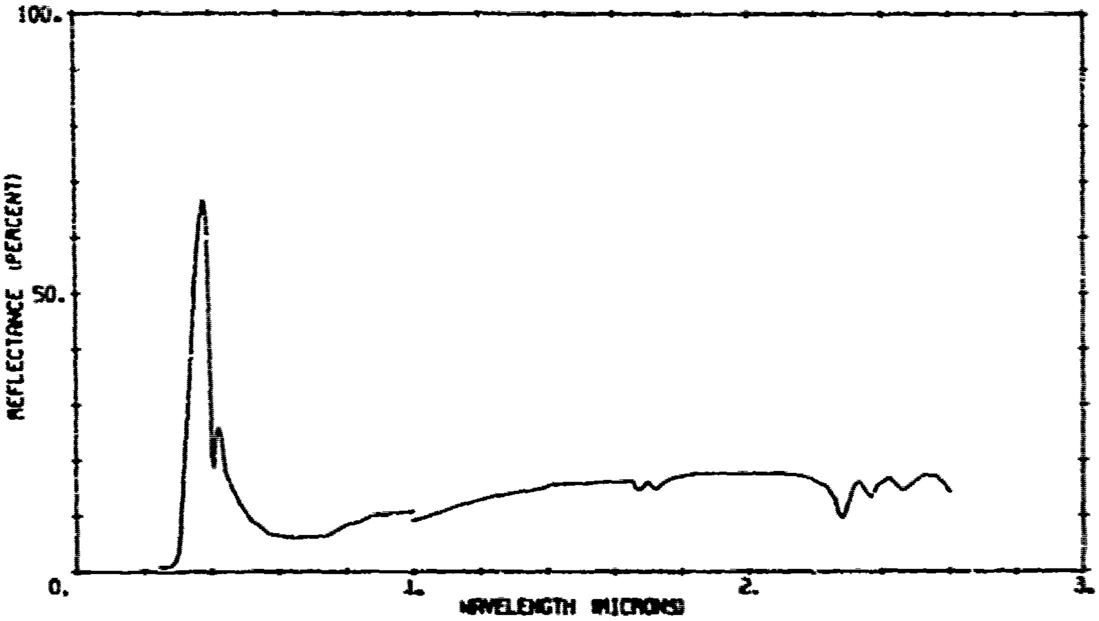
A03186 201 SOLAR CELL ARRAY, H-TYPE



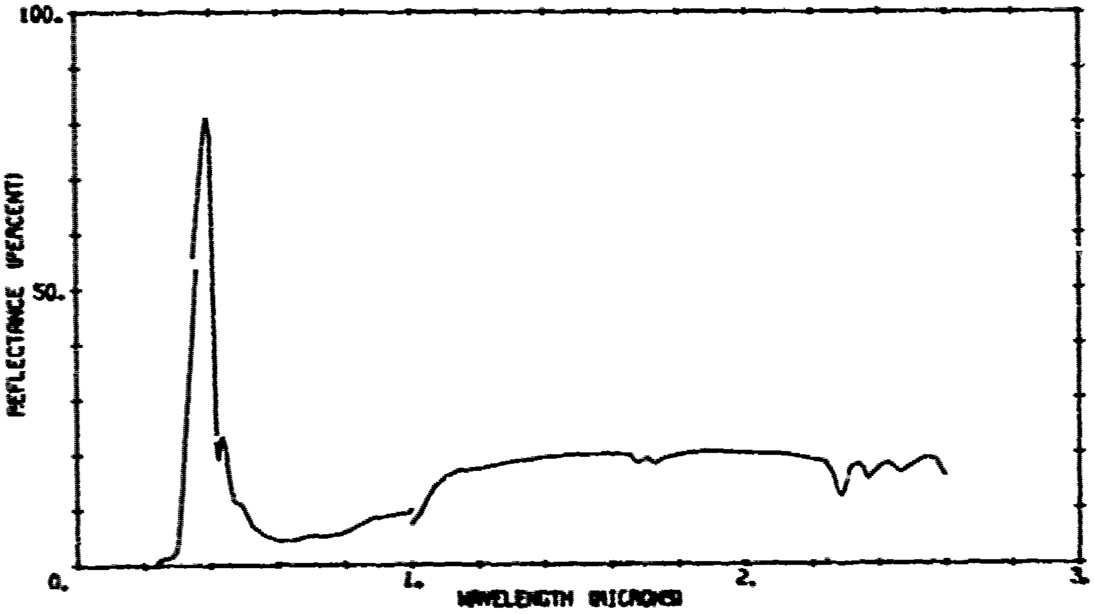
A03186 101 SOLAR CELL ARRAY, H-TYPE



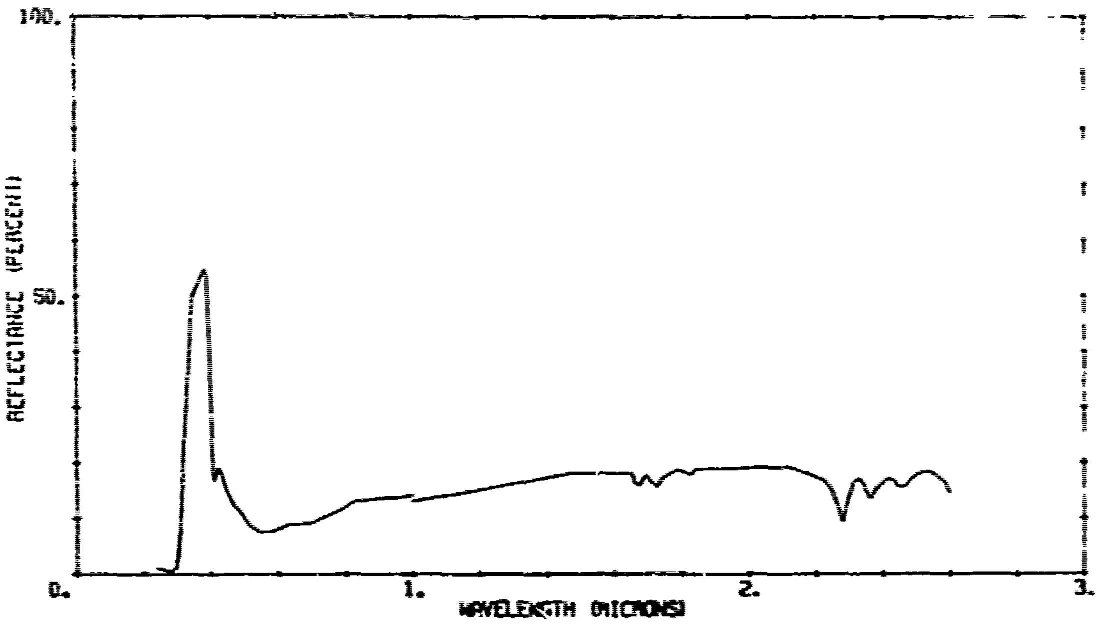
A03187 10J SOLAR CELL ARRAY, C-TYPE



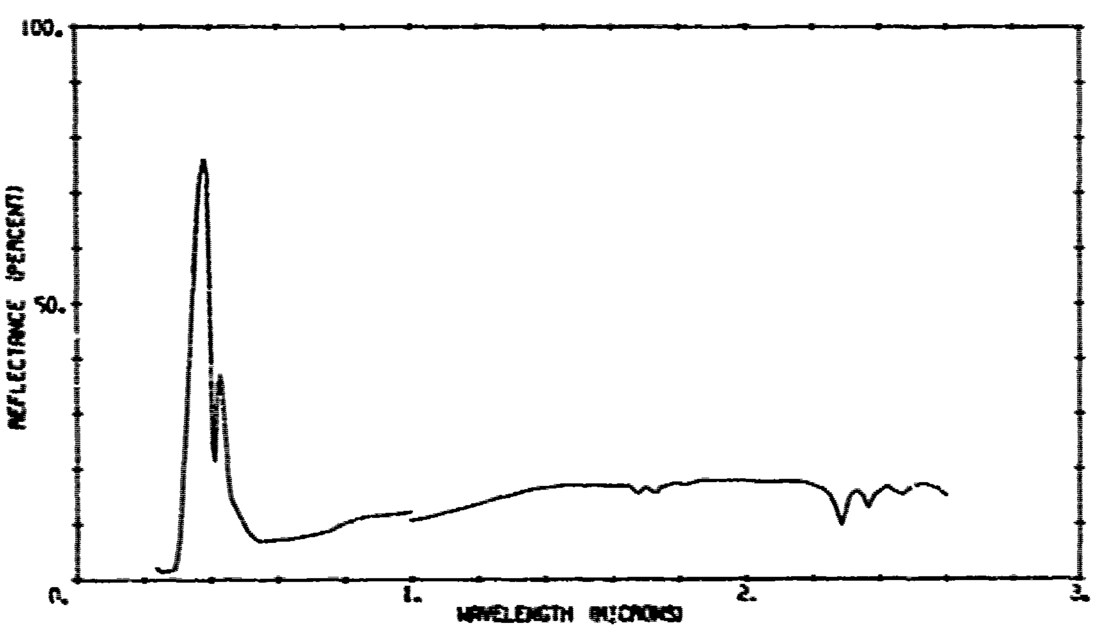
A03186 301 SOLAR CELL ARRAY, H-TYPE



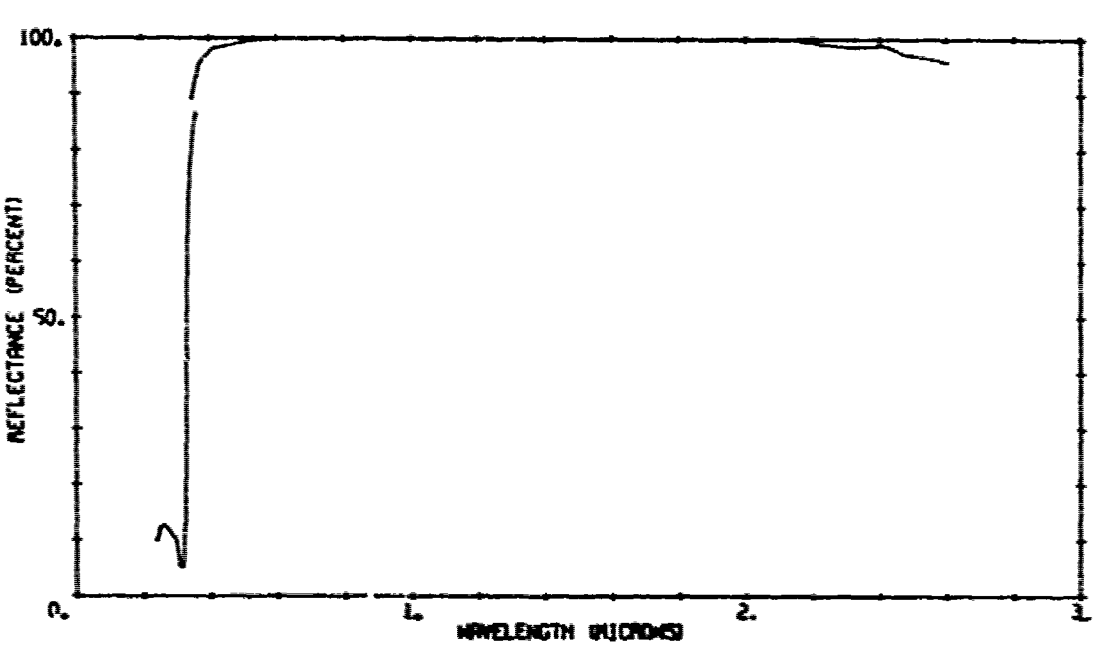
A03187 301 SOLAR CELL ARRAY, C-TYPE



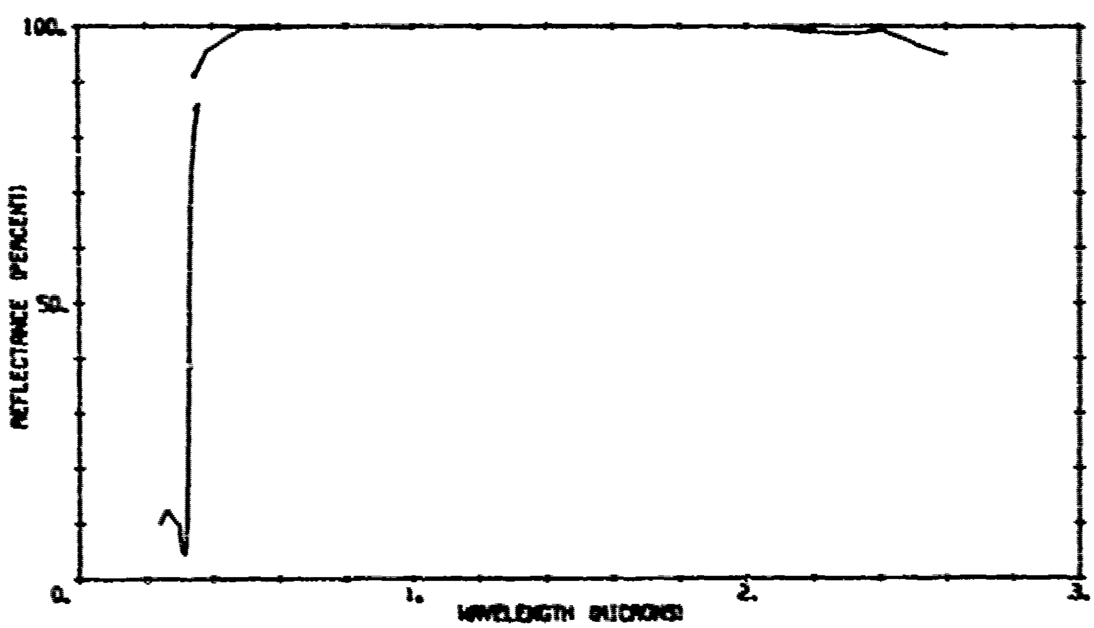
A03187 201 SOLAR CELL ARRAY, C-TYPE



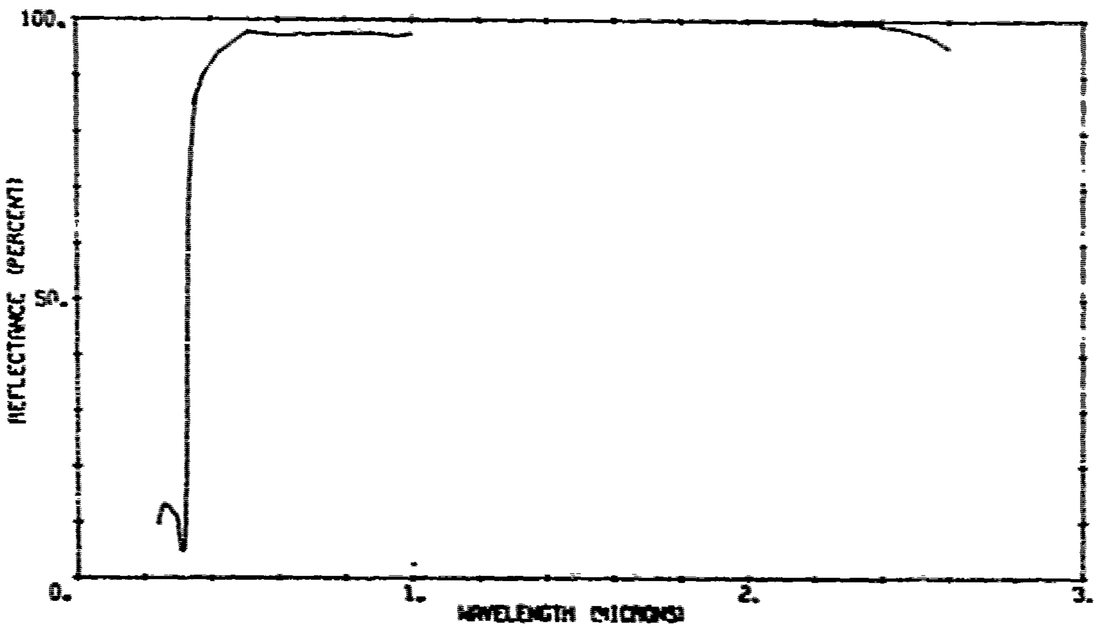
A03190 201 AEROJET SECOND SURFACE MIRROR ARRAY



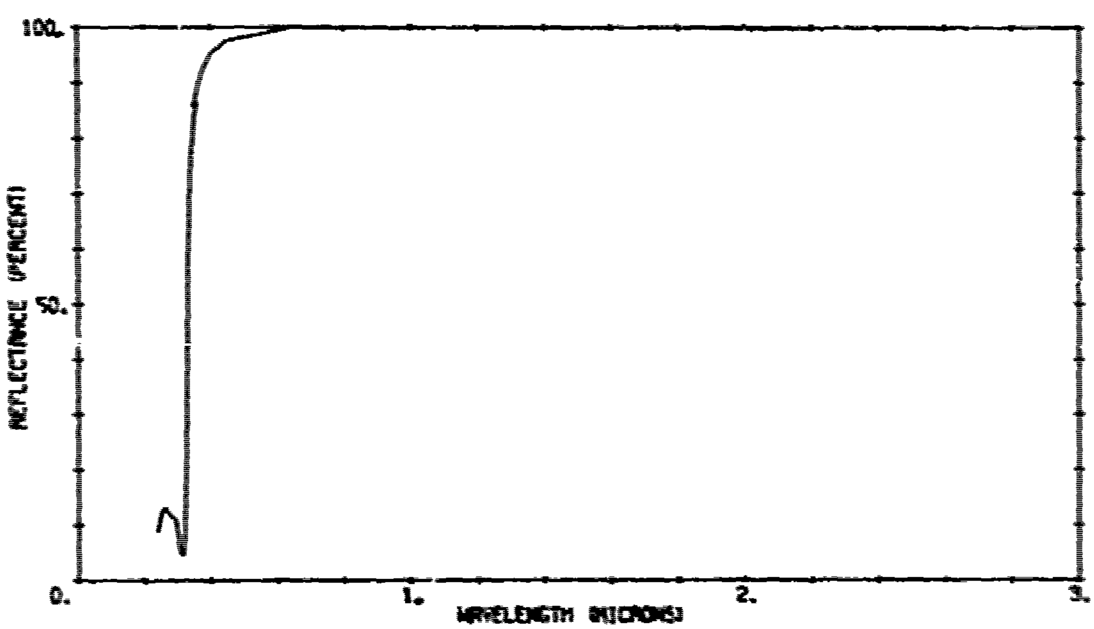
A03190 101 AEROJET SECOND SURFACE MIRROR ARRAY



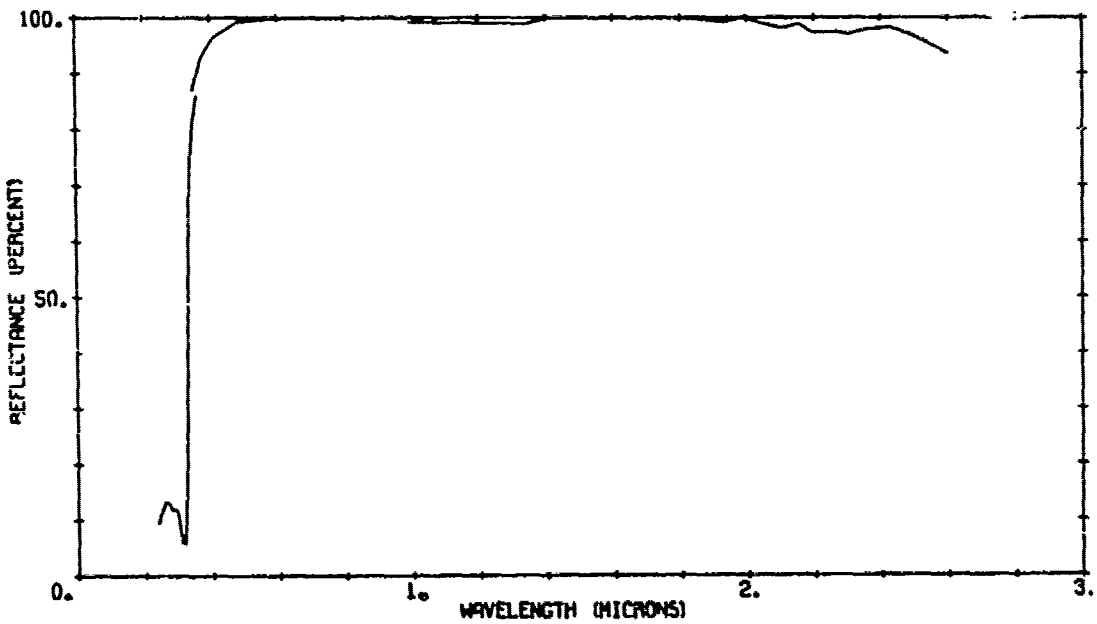
A03192 101 AEROJET SECOND SURFACE MIRROR ARRAY



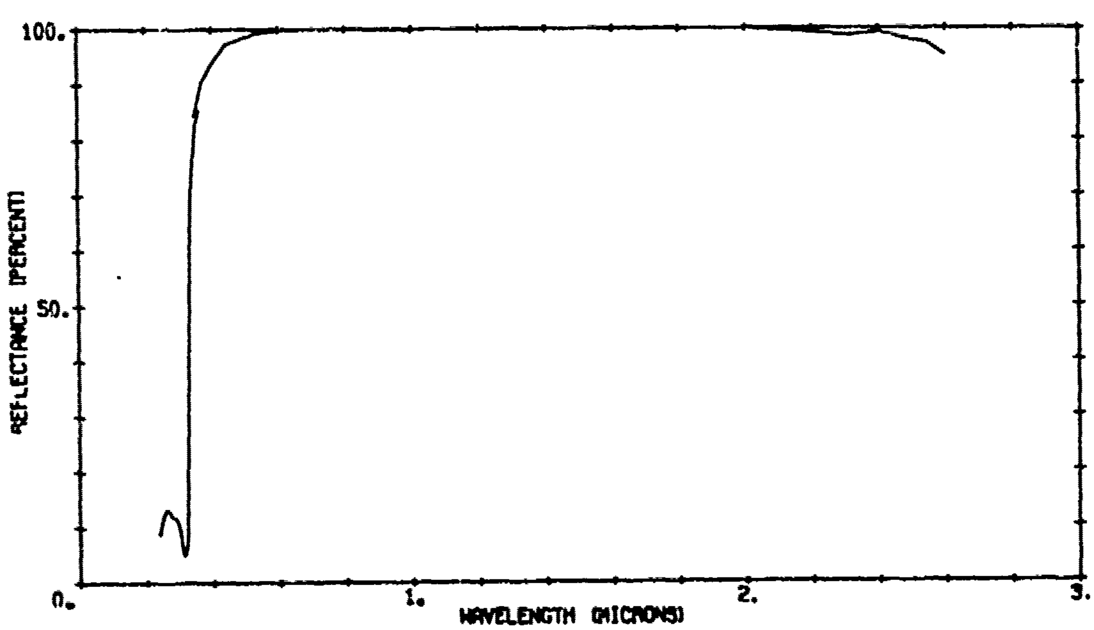
A03190 301 AEROJET SECOND SURFACE MIRROR ARRAY



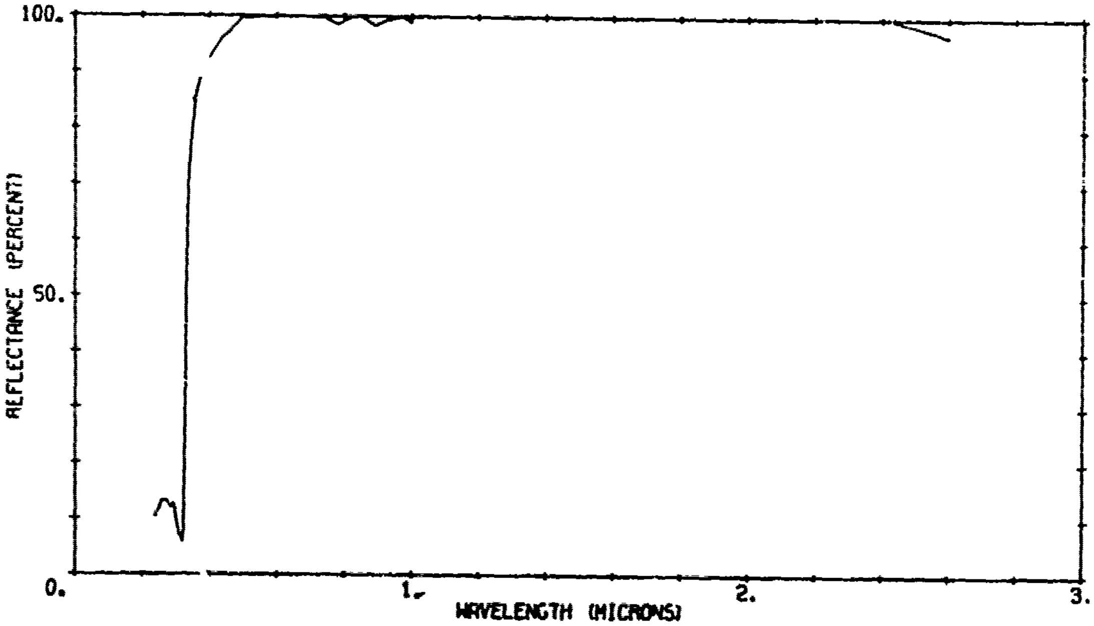
A03192 301 AEROJET SECOND SURFACE MIRROR ARRAY



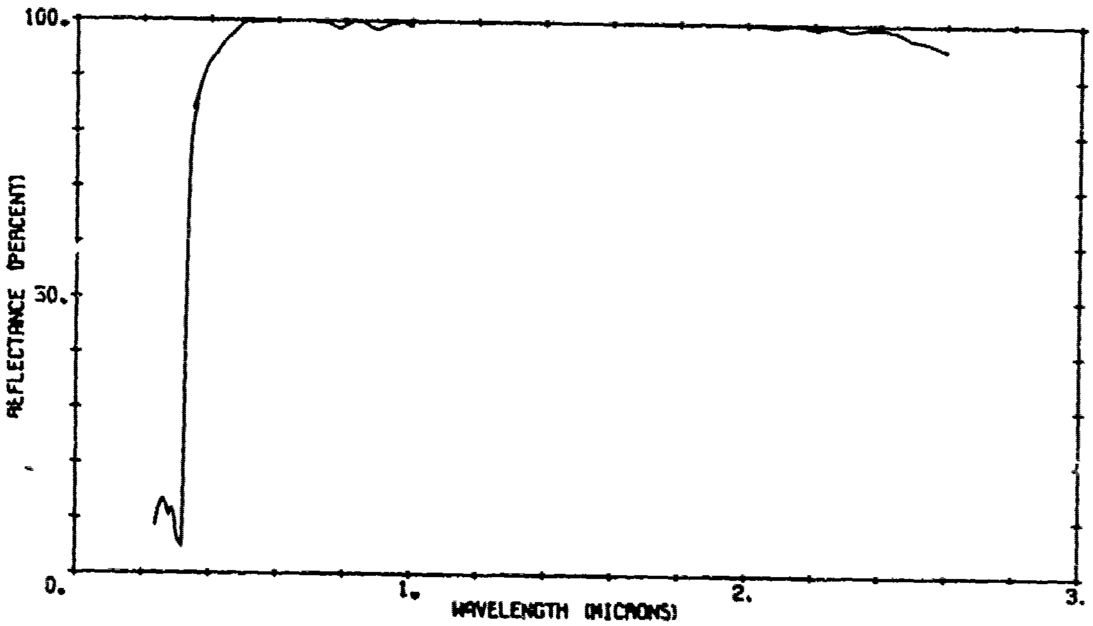
A03192 201 AEROJET SECOND SURFACE MIRROR ARRAY



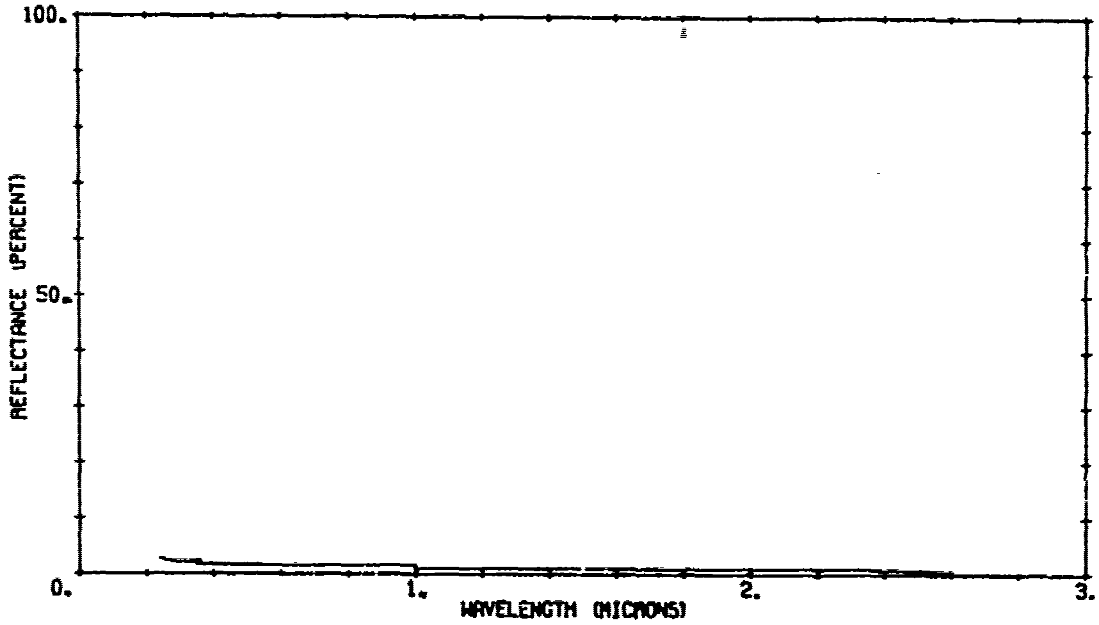
A03194 201 AEROJET SECOND SURFACE MIRROR ARRAY



A03194 101 AEROJET SECOND SURFACE MIRROR ARRAY

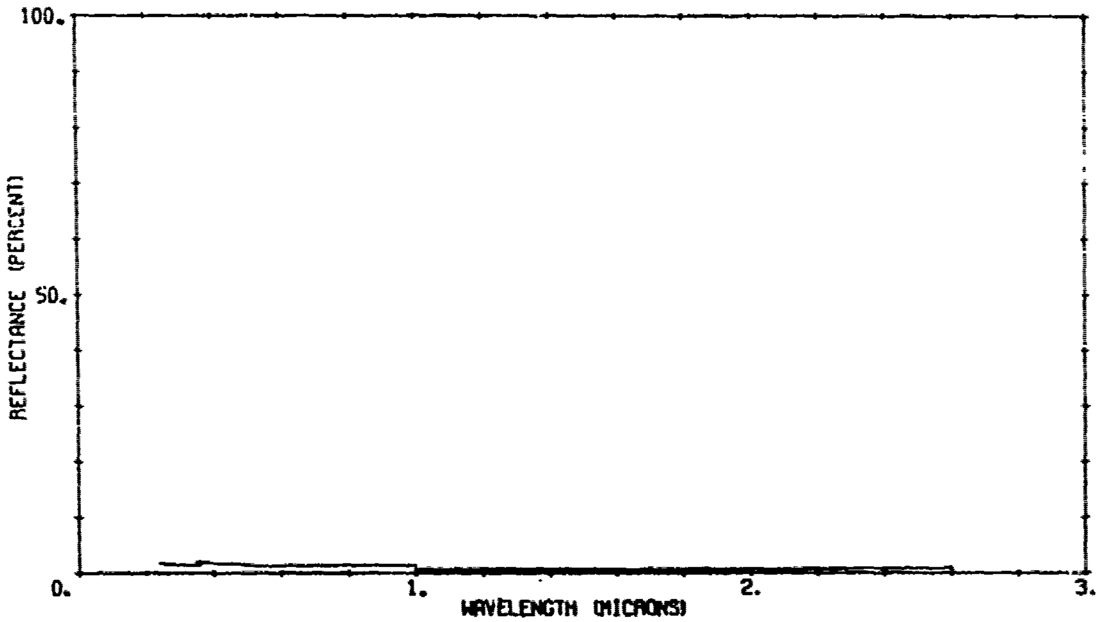


A03197 101 3M BLACK VELVET PAINT, 101-C10

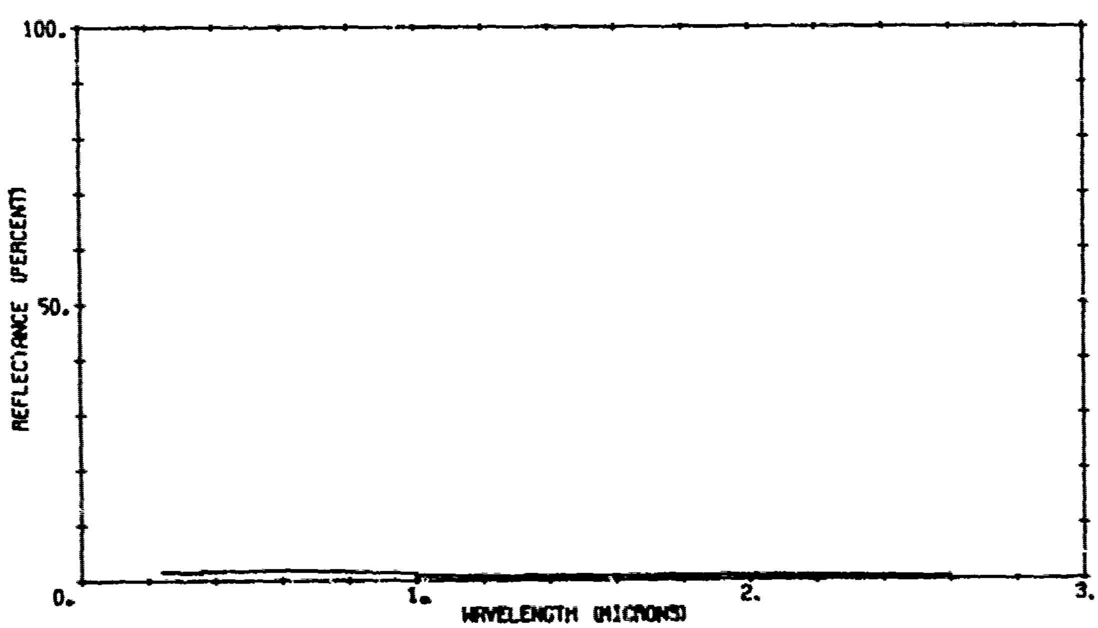


A03194 301 AEROJET SECOND SURFACE MIRROR ARRAY

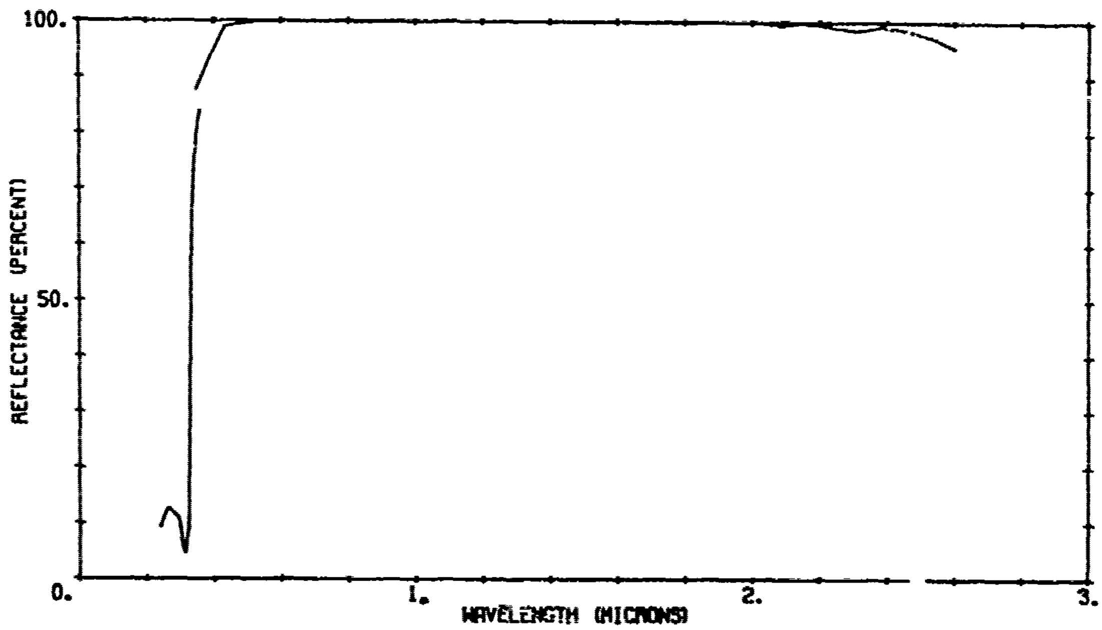
A03198 101 3M BLACK VELVET PAINT, 101-C10



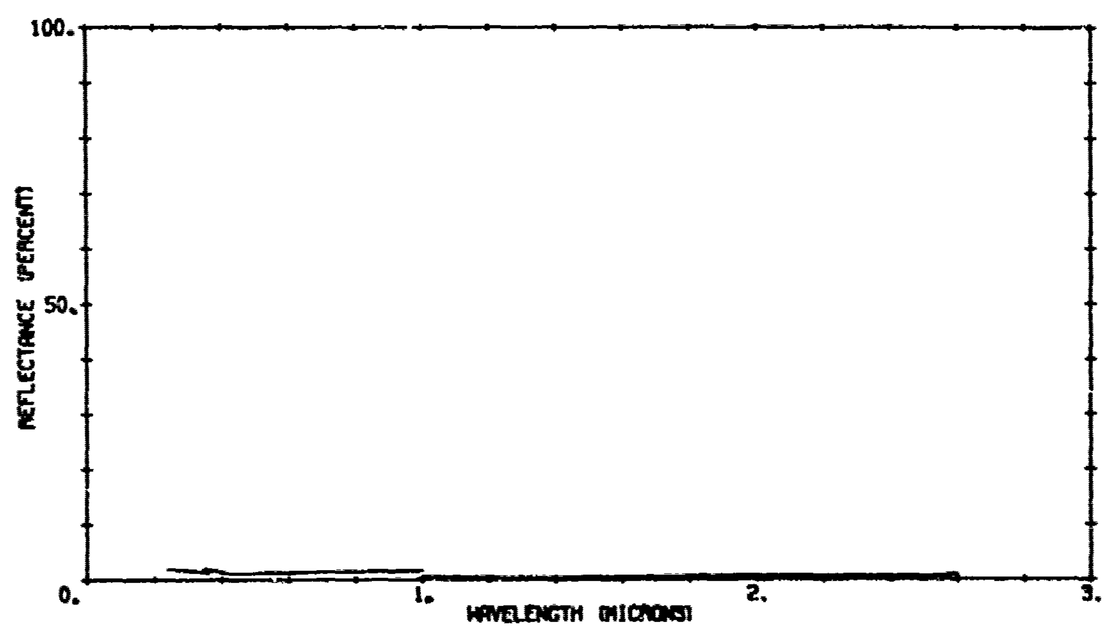
A0319? 201 3M BLACK VELVET PAINT, 101-C10



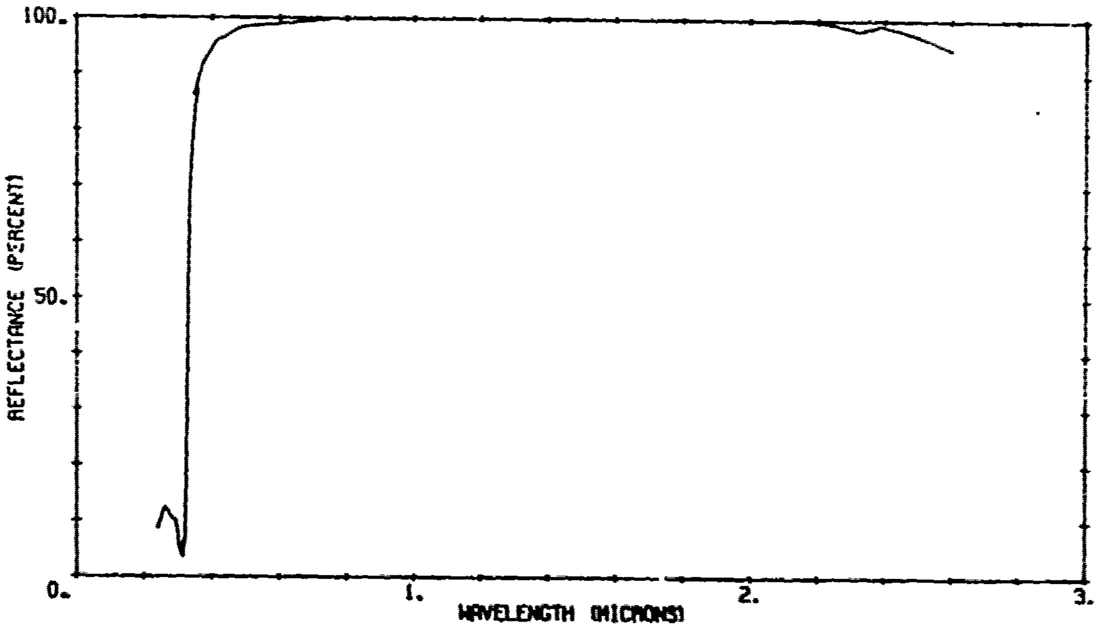
A03200 101 AEROJET SECOND SURFACE MIRROR ARRAY



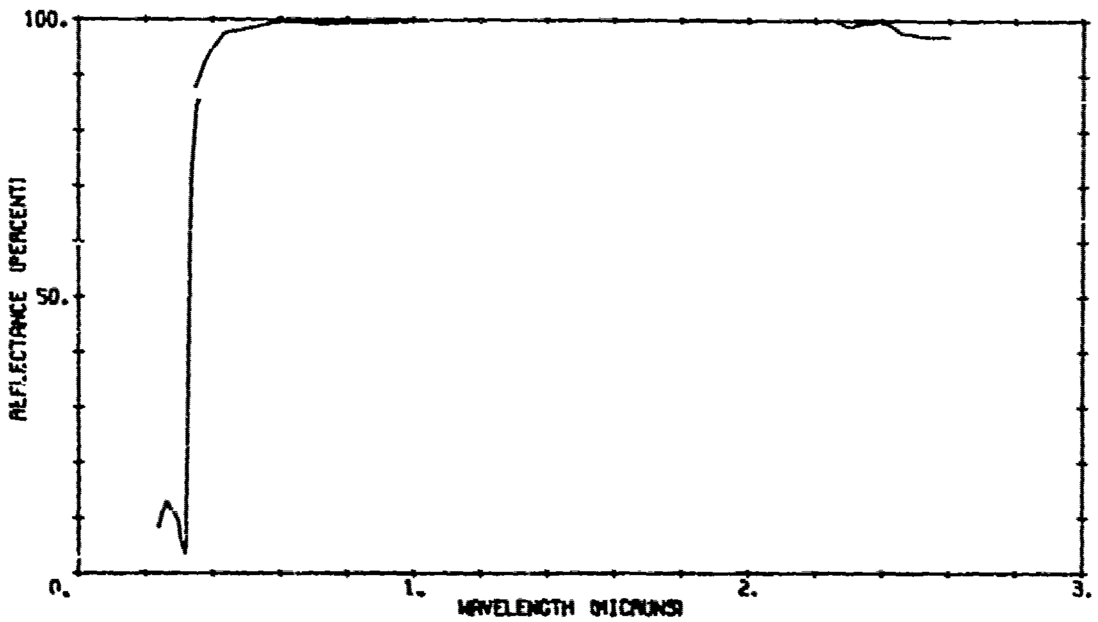
A03198 201 3M BLACK VELVET PAINT, 101-C10



A03200 301 AEROJET SECOND SURFACE MIRROR ARRAY

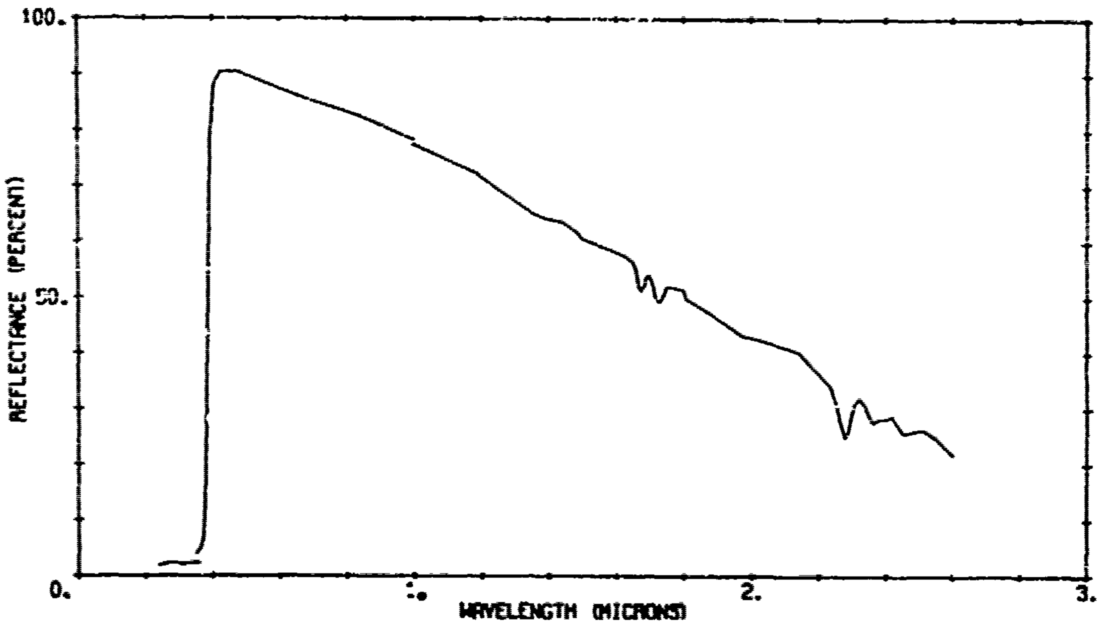


A03200 201 AEROJET SECOND SURFACE MIRROR ARRAY



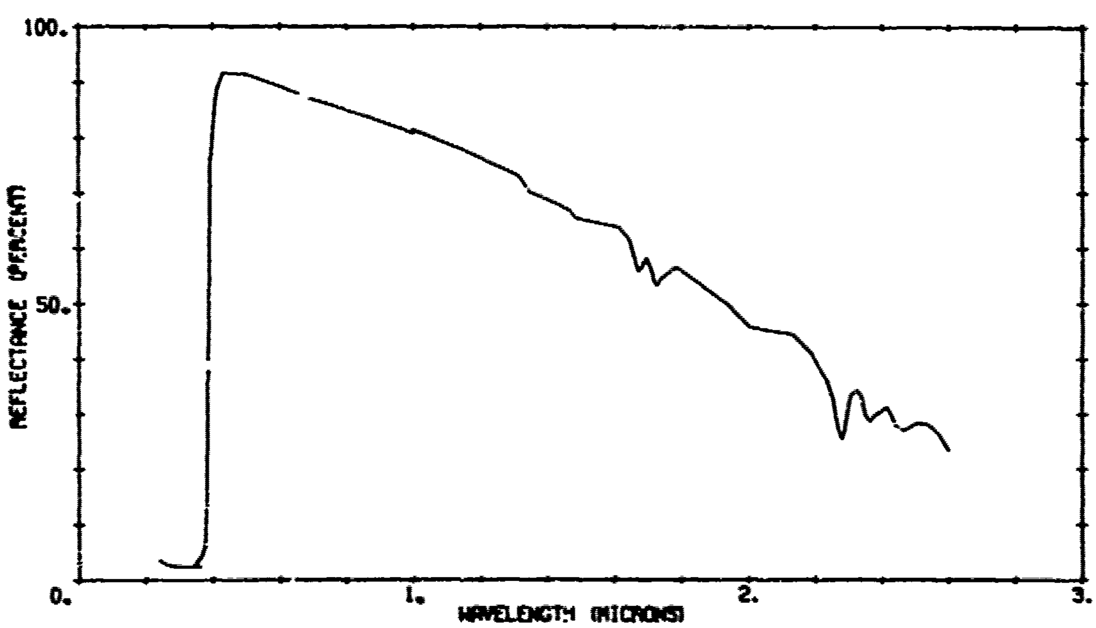
A03206 201

AEROJET WHITE PAINT 0.008-0.010 THICK,
TELESCOPE SUBSTRATE

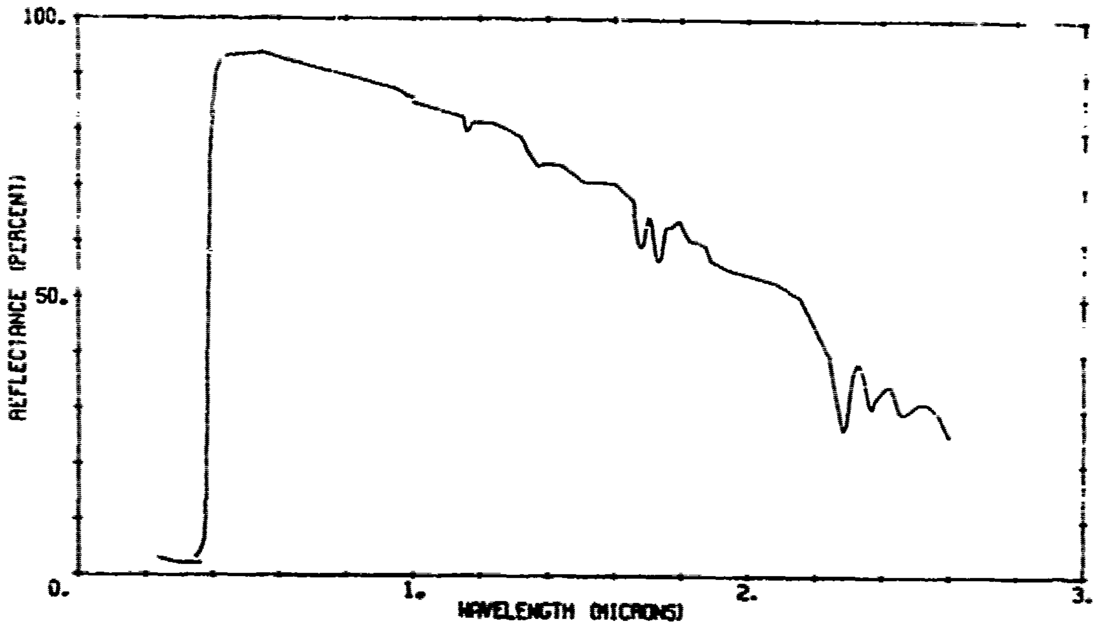


A03206 101

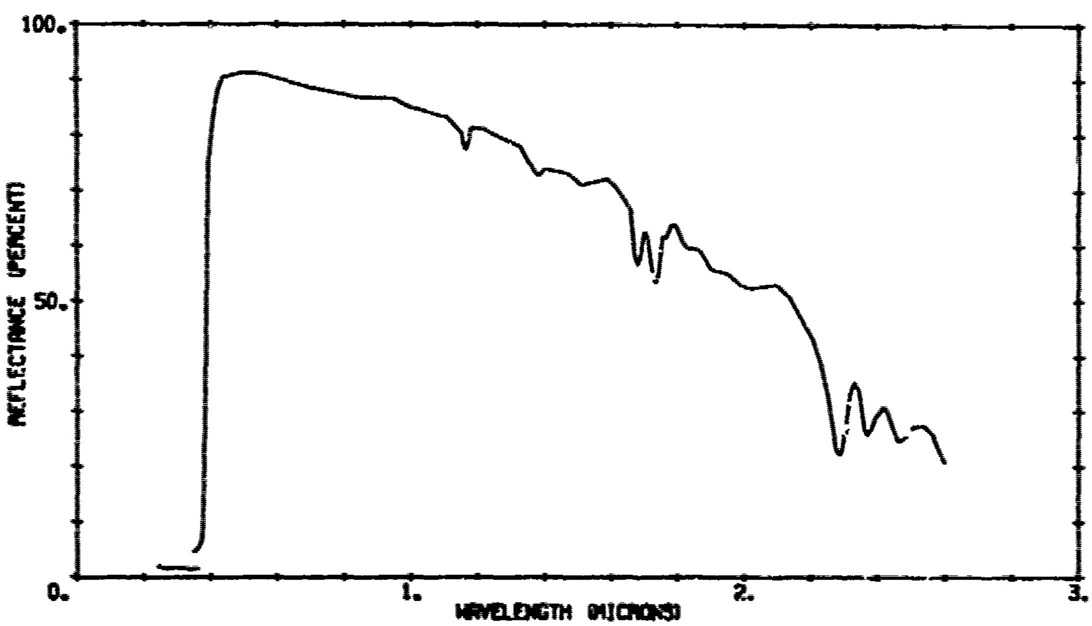
AEROJET WHITE PAINT 0.008-0.010 THICK,
TELESCOPE SUBSTRATE



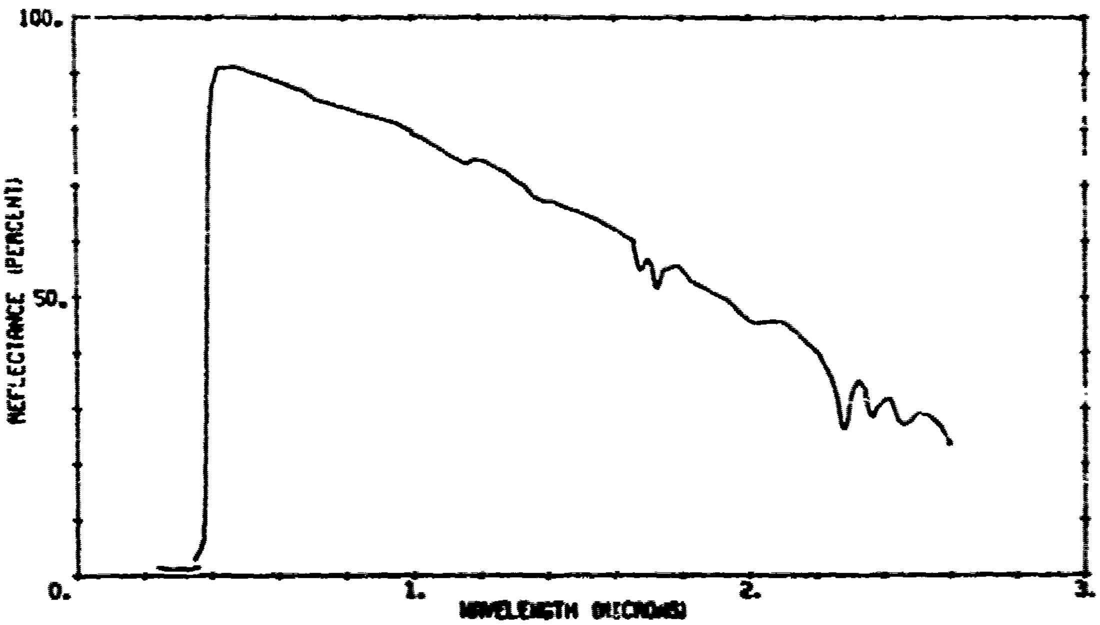
A03207 201 AEROJET WHITE PAINT 0.008-0.010 THICK, TELESCOPE SUBSTRATE



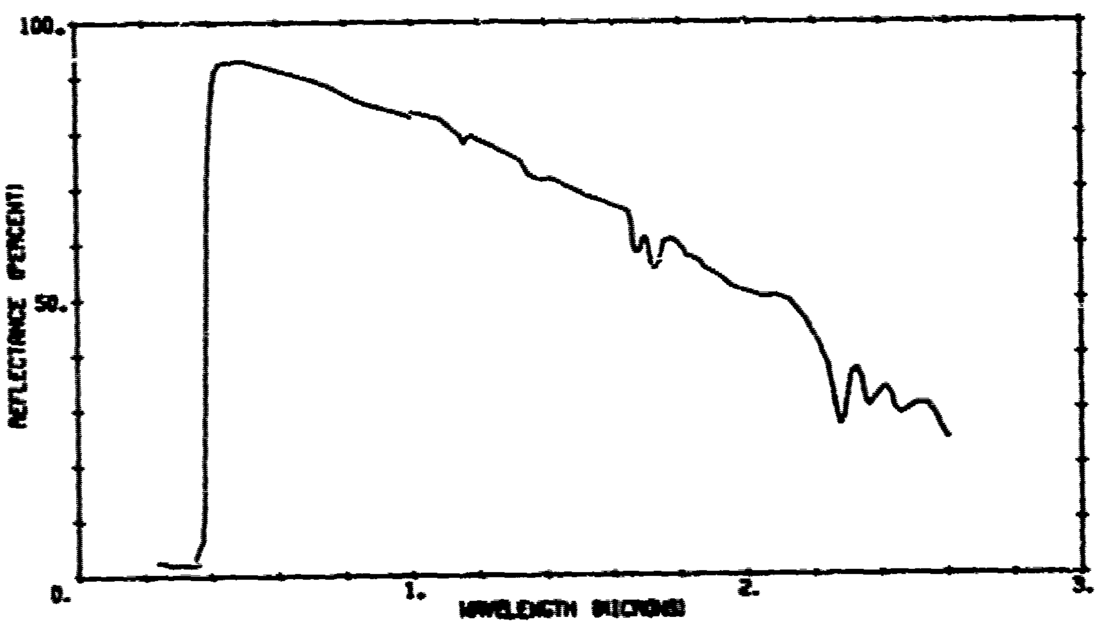
A03207 101 AEROJET WHITE PAINT 0.008-0.010 THICK, TELESCOPE SUBSTRATE



A03209 201 AEROJET WHITE PAINT, STAR SENSOR SUBSTRATE

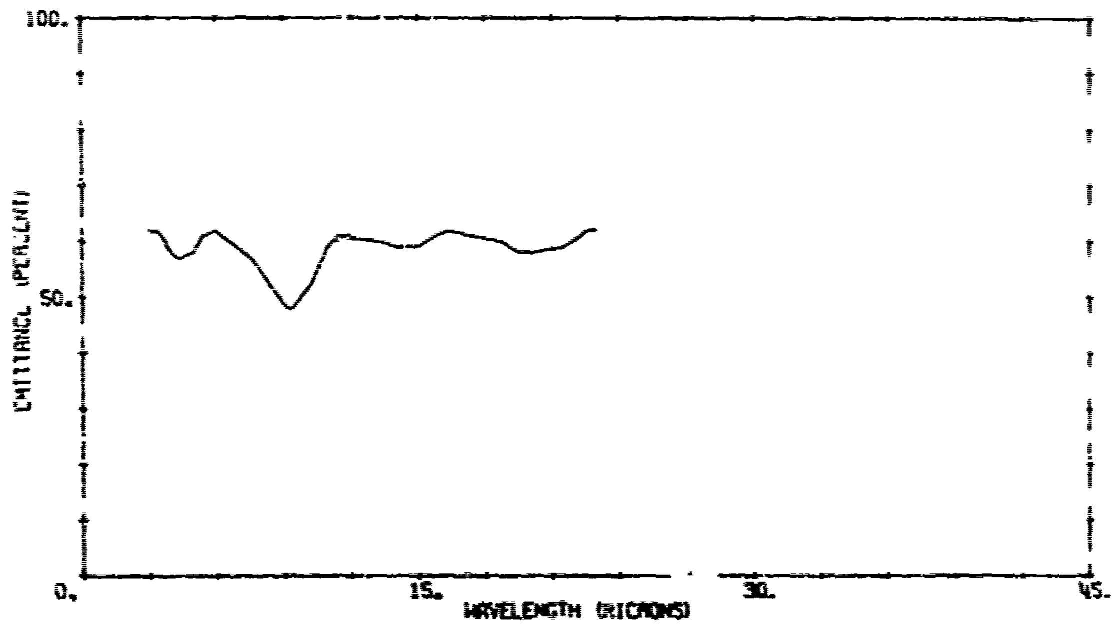


A03209 101 AEROJET WHITE PAINT, STAR SENSOR SUBSTRATE



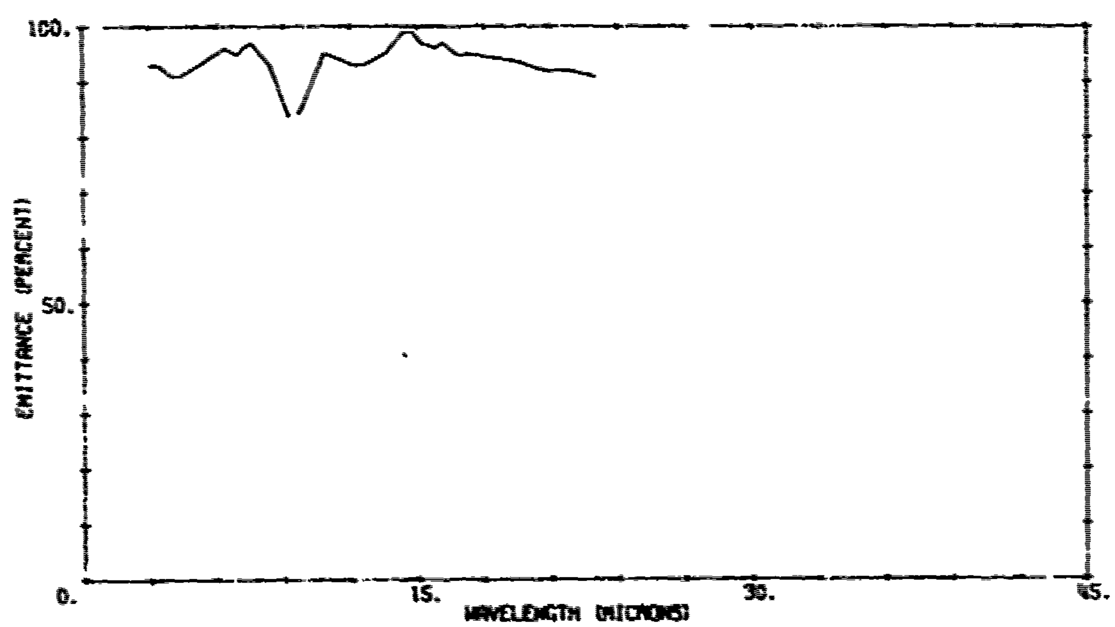
A03212 102

3M BLACK VELVET PAINT, 401-C10
$\theta_r = 80.0°$ T = 300°K



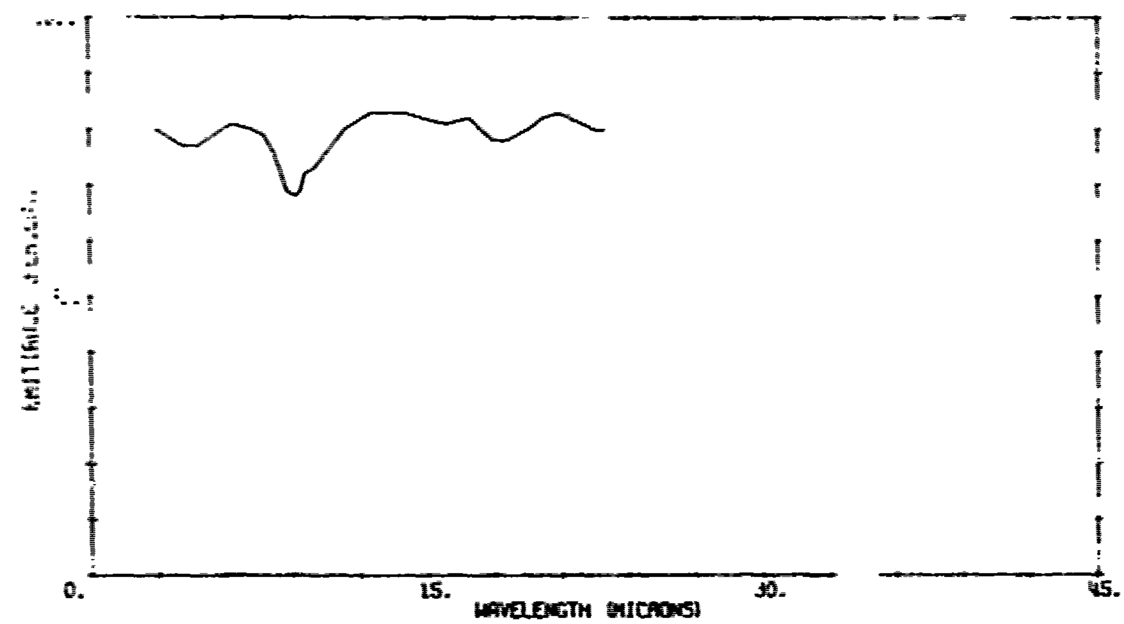
A03212 101

3M BLACK VELVET PAINT, 401-C10
$\theta_r = 0.0°$ T = 300°K



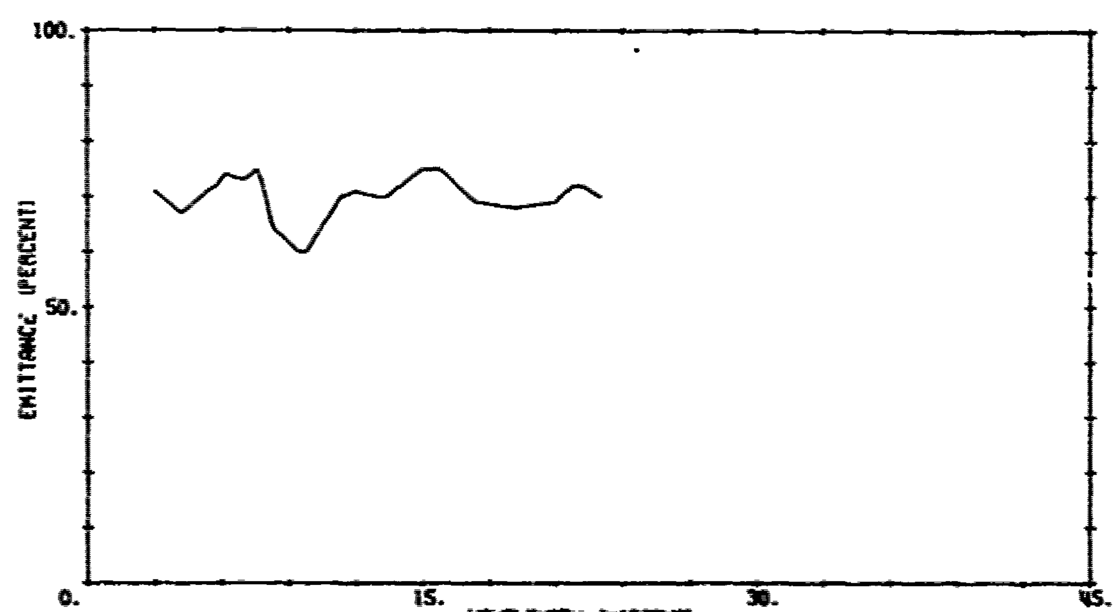
403212 104

3M BLACK VELVET PAINT, 401-C10
$\theta_r = 70.0^{\circ}$ $T = 300^{\circ}K$



A03212 103

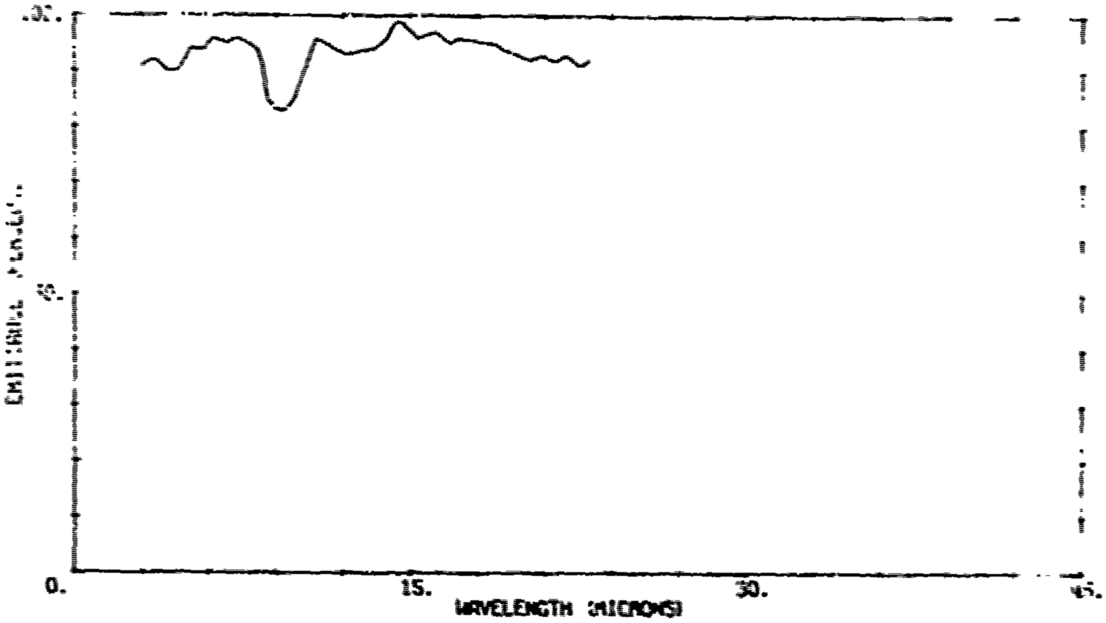
3M BLACK VELVET PAINT, 401-C10
$\theta_r = 75.0^{\circ}$ $T = 300^{\circ}K$



A03212 105

3M BLACK VELVET PAINT, 401-C10

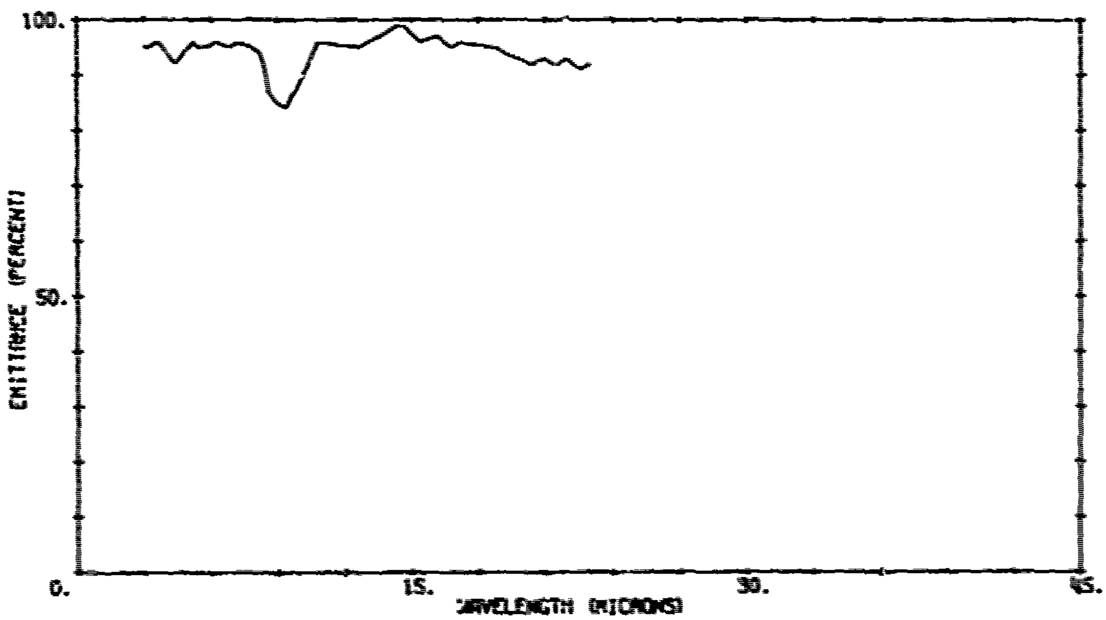
θ_r = 4[illegible].0° T = 300°K



A03212 105

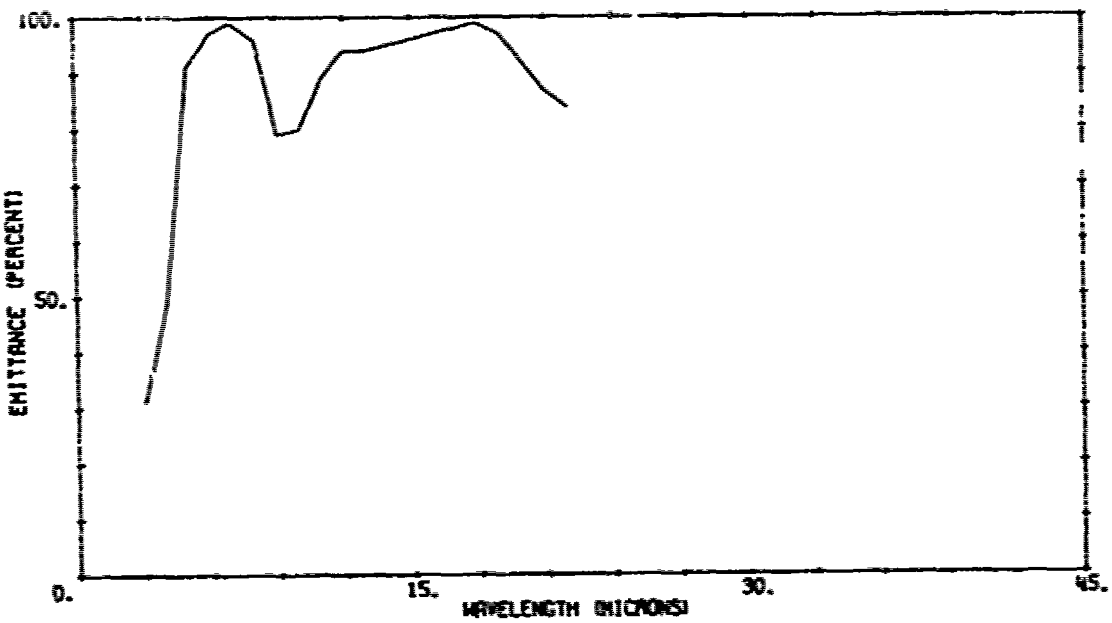
3M BLACK VELVET PAINT, 401-C10

θ_r = 0.0° T = 300°K



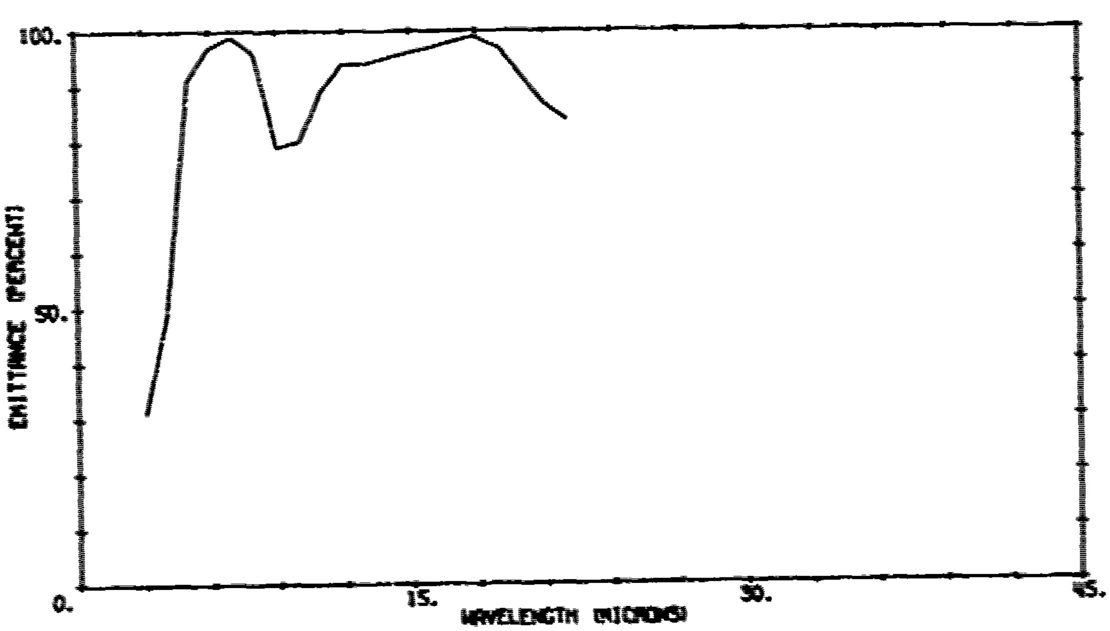
A03213 102

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 10.0^\circ$ T = 200°K



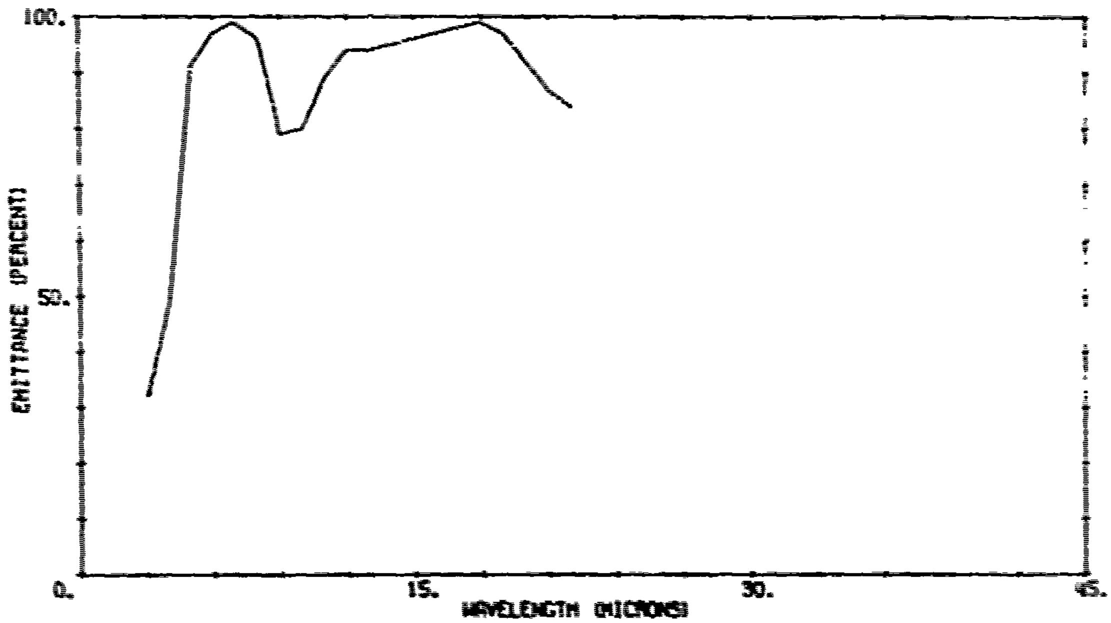
A03213 101

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 0.0^\circ$ T = 200°K



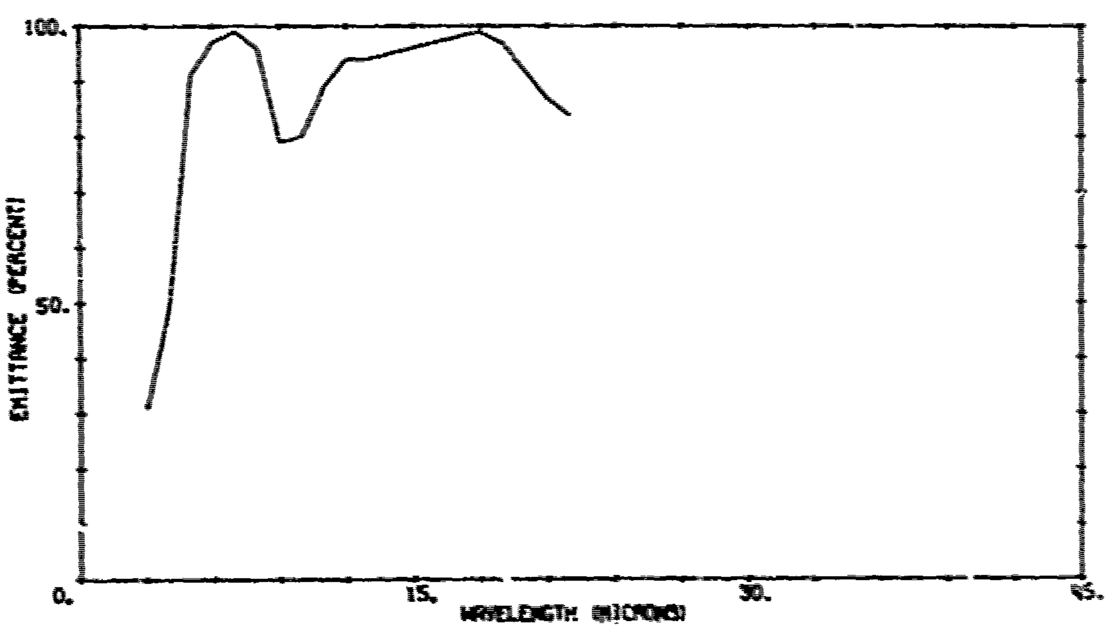
A03213 104

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 30.0^\circ$ $T = 200^\circ K$



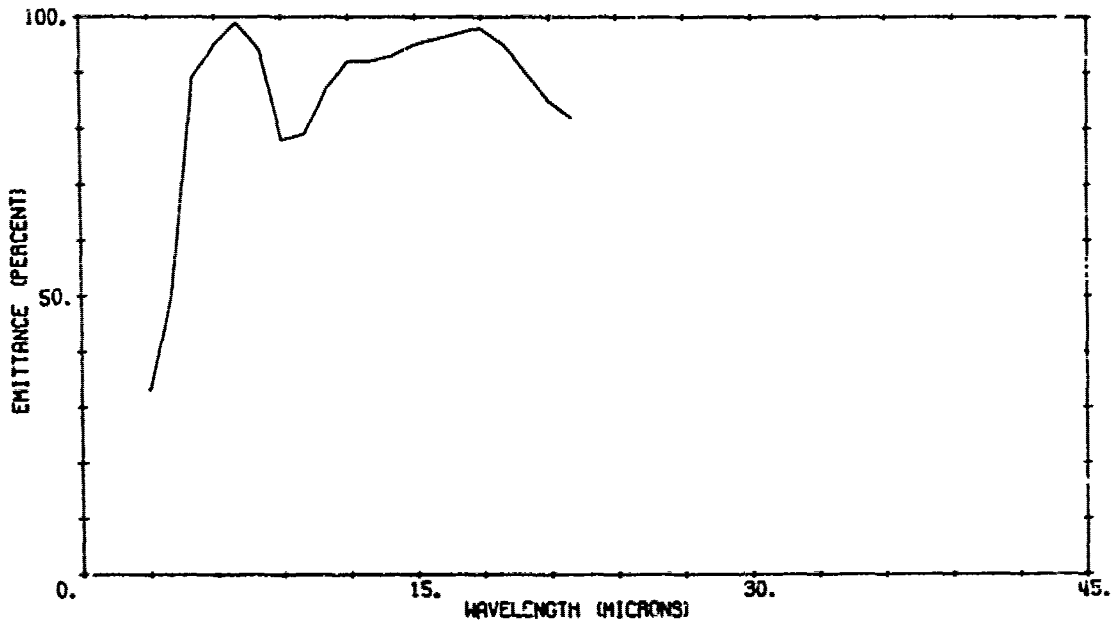
A03213 103

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 30.0^\circ$ $T = 200^\circ K$



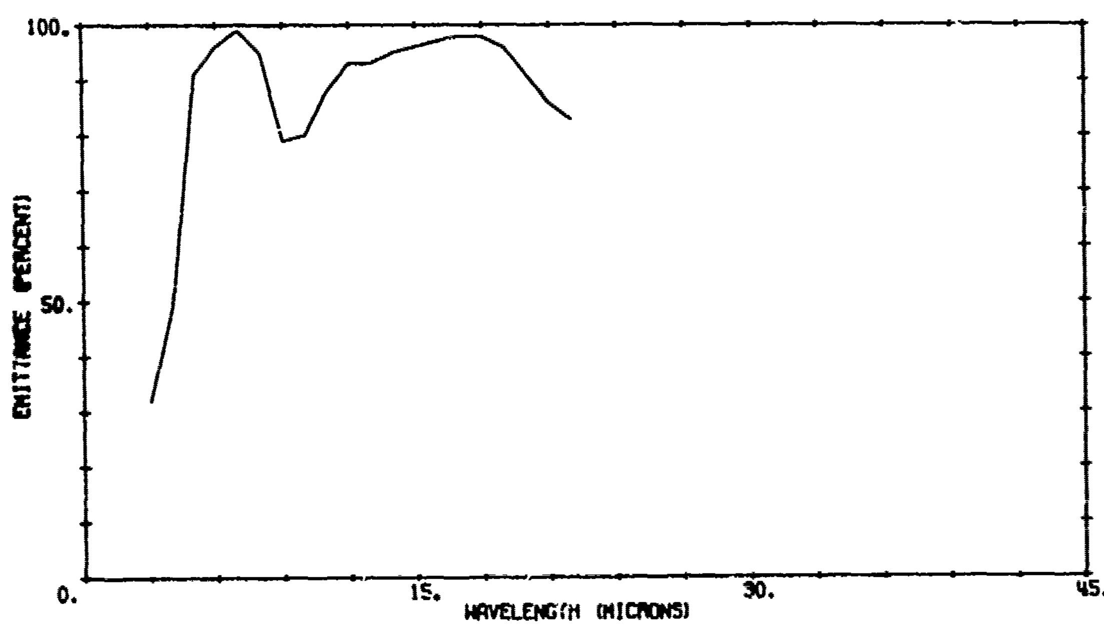
A03213 106

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 50.0^{\circ}$ $T = 200^{\circ}K$



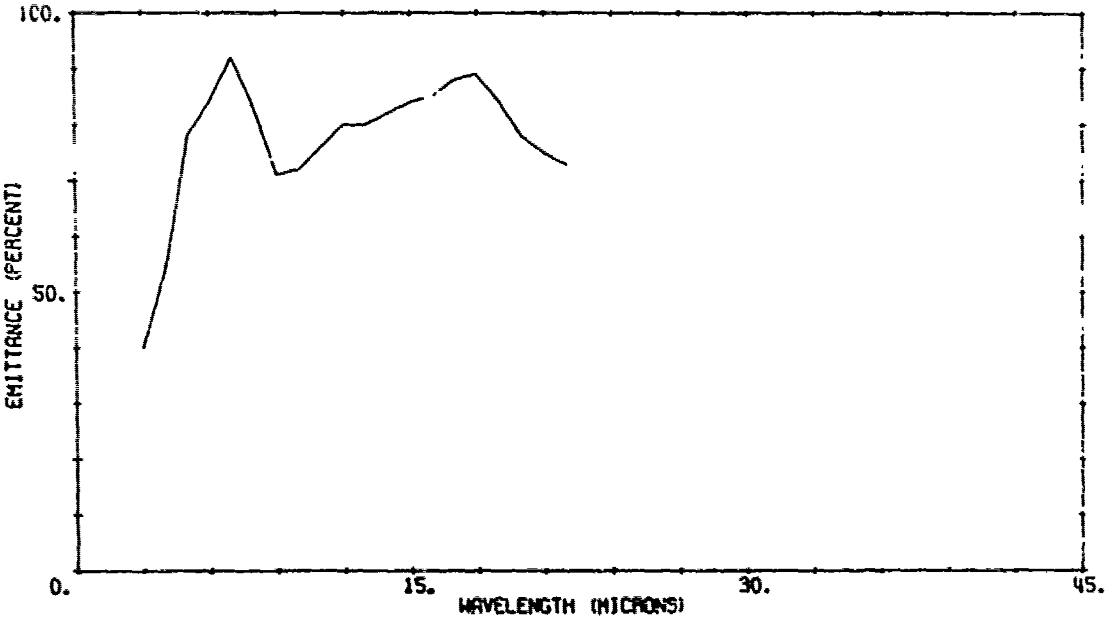
A03213 105

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 40.0^{\circ}$ $T = 200^{\circ}K$



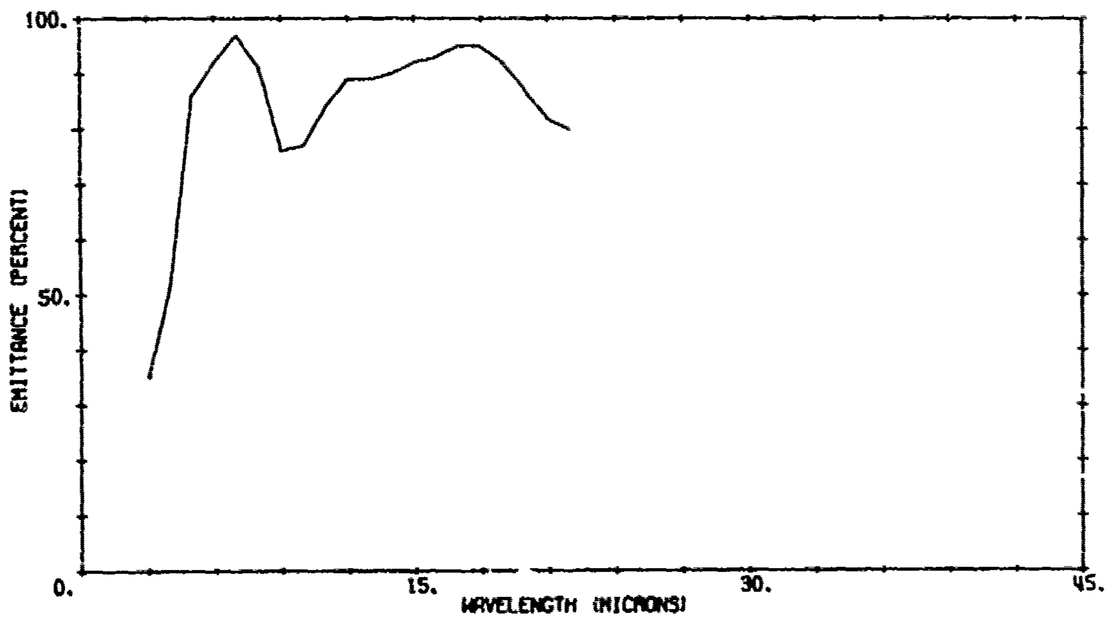
A03213 108

SFCOND SURFACE MIRROK, AEROJET
$\theta_r = 70.0^\circ$ $T = 200^\circ K$



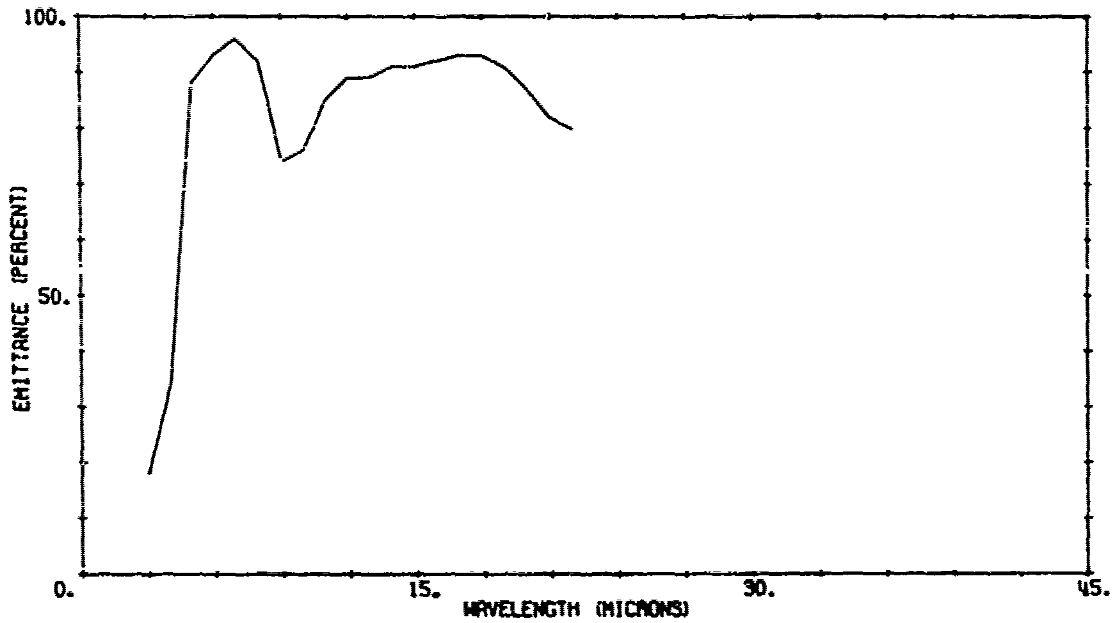
A03213 107

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 60.0^\circ$ $T = 200^\circ K$



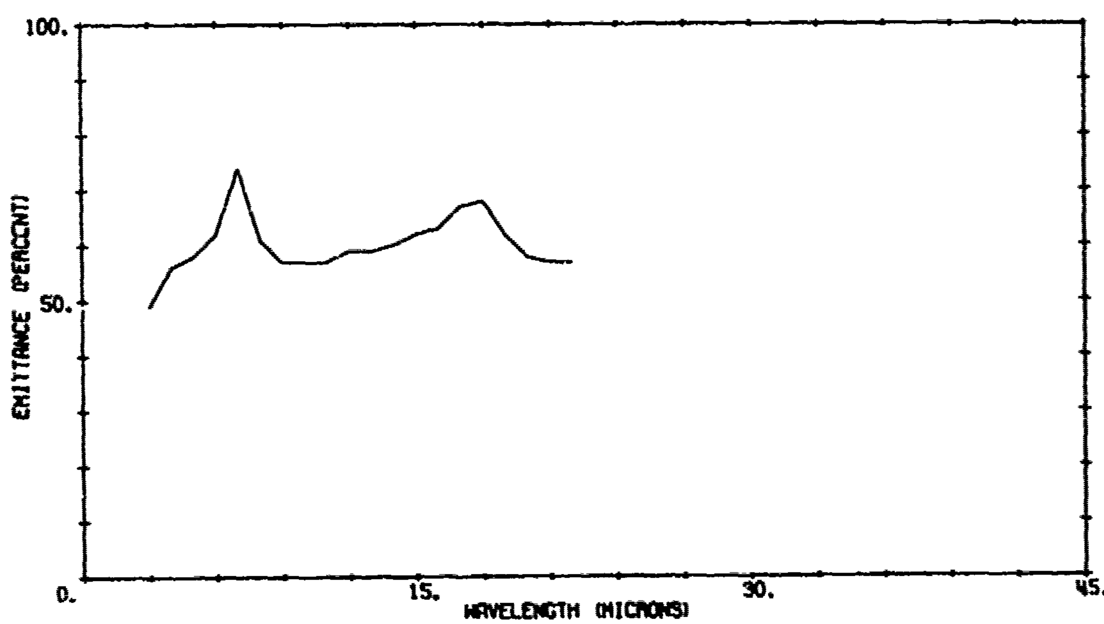
A03213 201

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 0.0^o$ T = 373°K



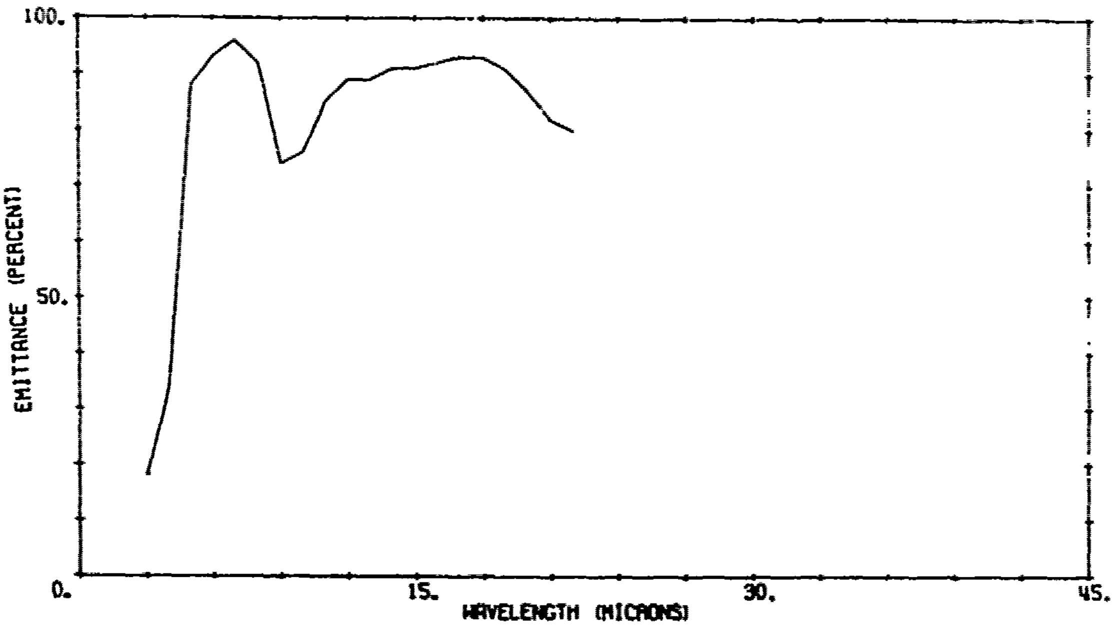
A03213 109

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 80.0^o$ T = 200°K



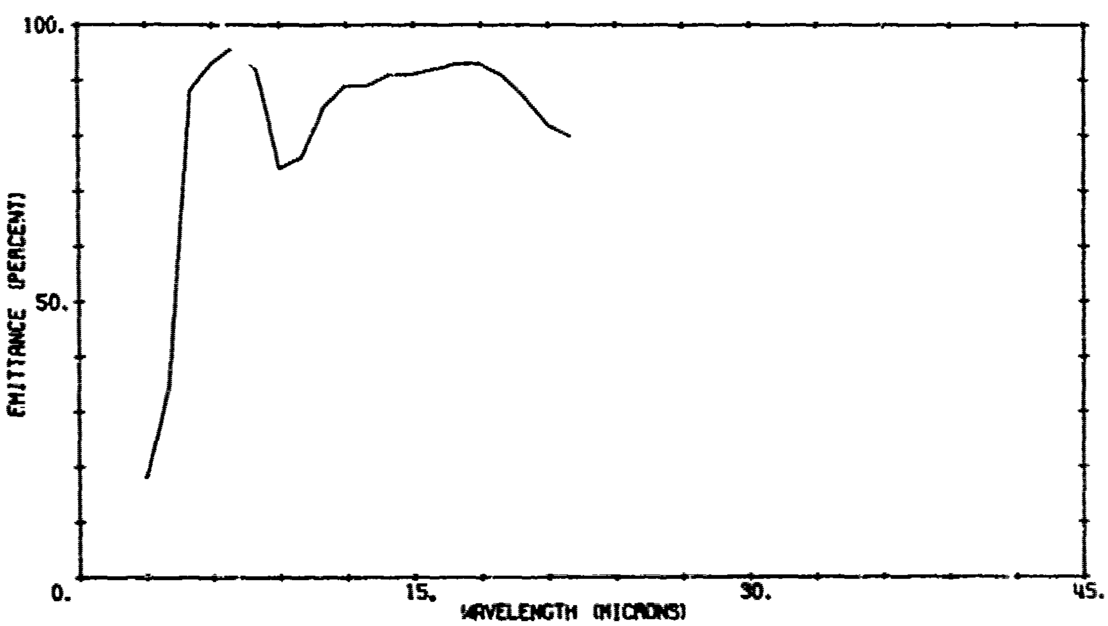
A03213 203

SECOND SURFACE MIRROR, AEROJET
θ_r = 20.0° T = 373°K



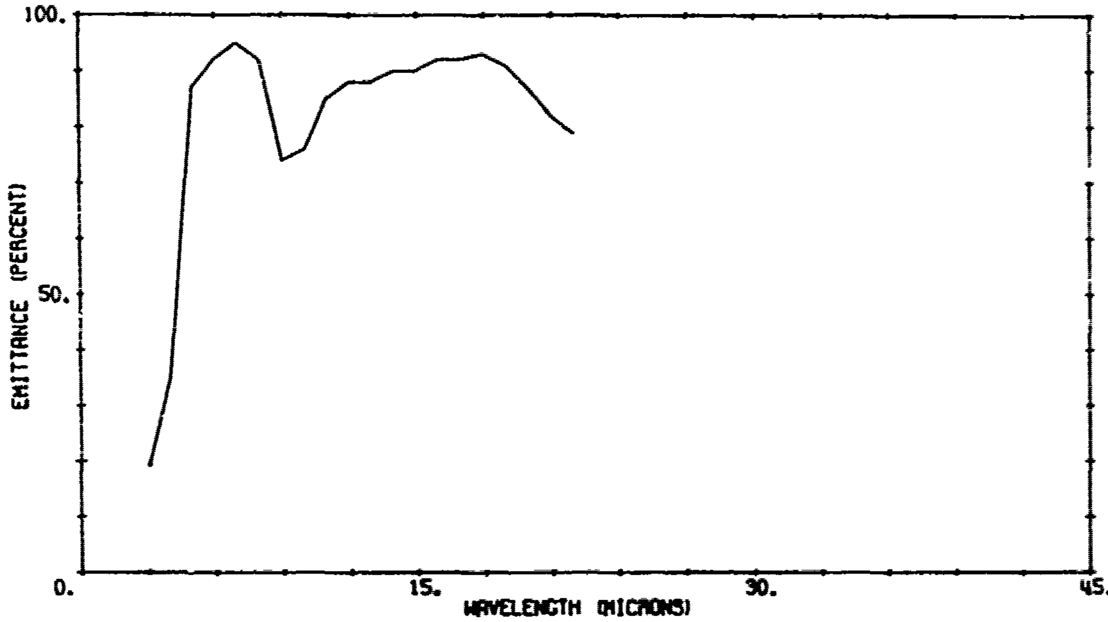
A03213 202

SECOND SURFACE MIRROR, AEROJET
θ_r = 10.0° T = 373°K



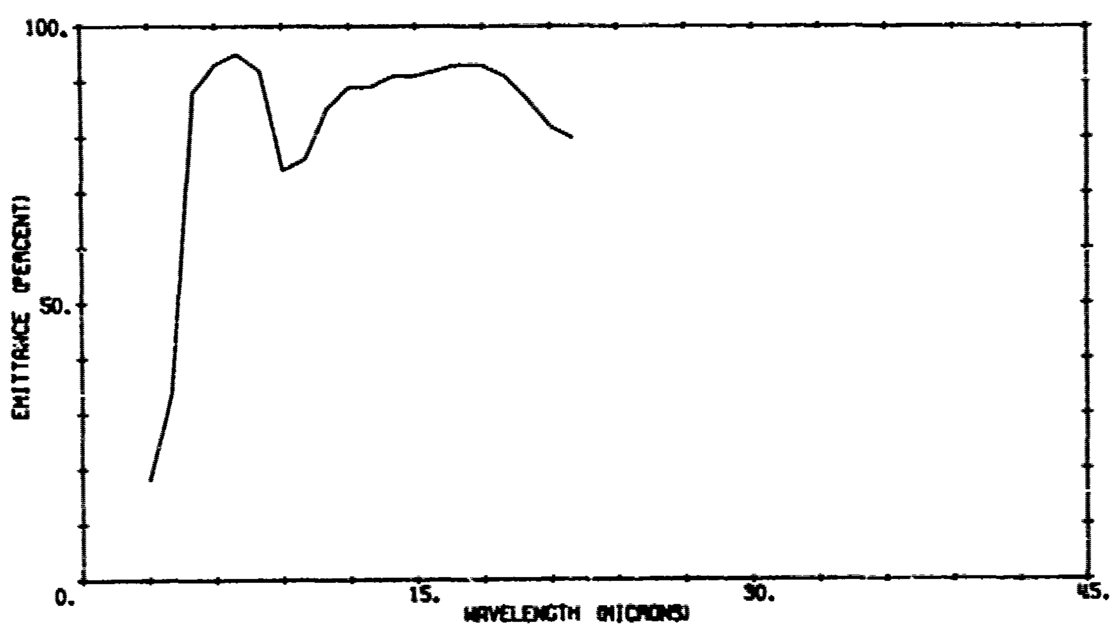
A03213 205

SECOND SURFACE MIRROR, AEROJET
$\theta_r = 40.0^\circ$ T = 373°K



A03213 204

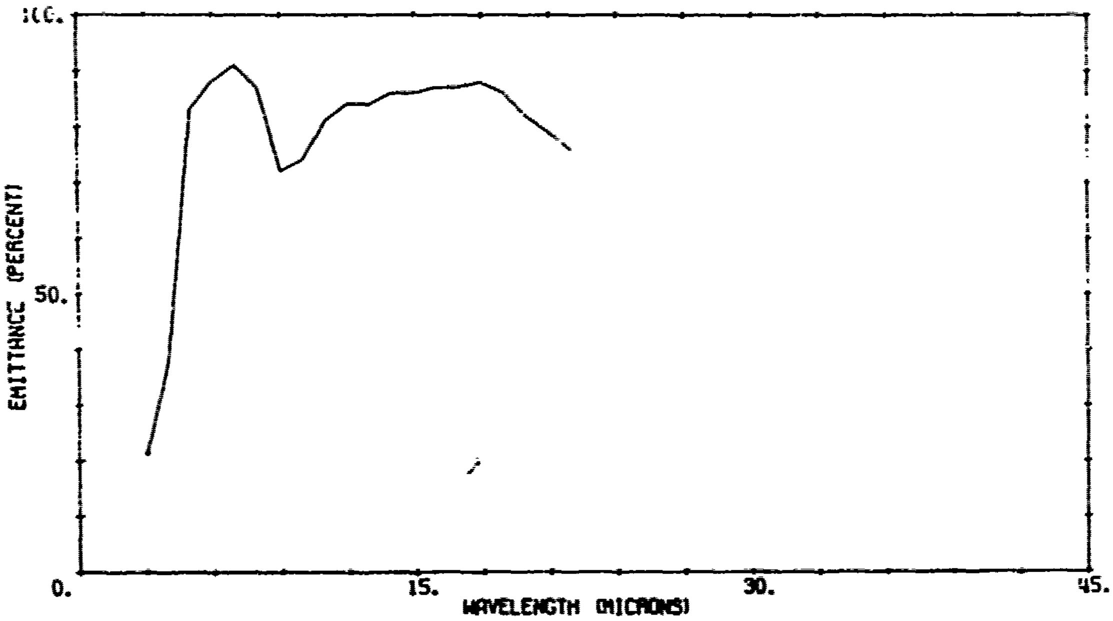
SECOND SURFACE MIRROR, AEROJET
$\theta_r = 30.0^\circ$ T = 373°K



AC3213 207

SECOND SURFACE MIRROR, AEROJET

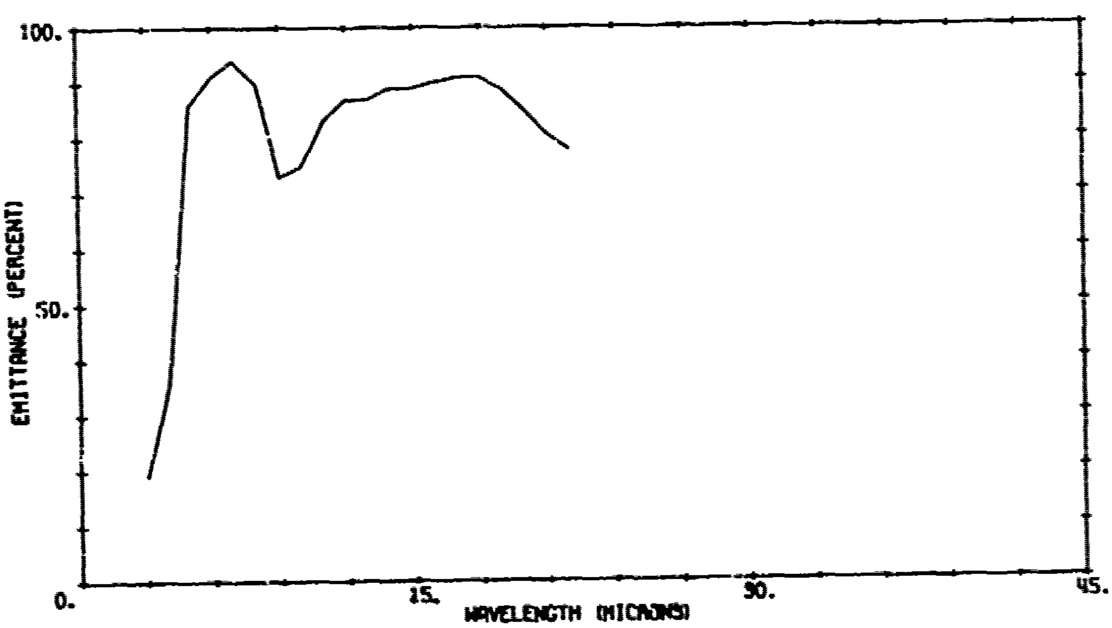
θ_r = 60.0° T = 373°K



A03213 206

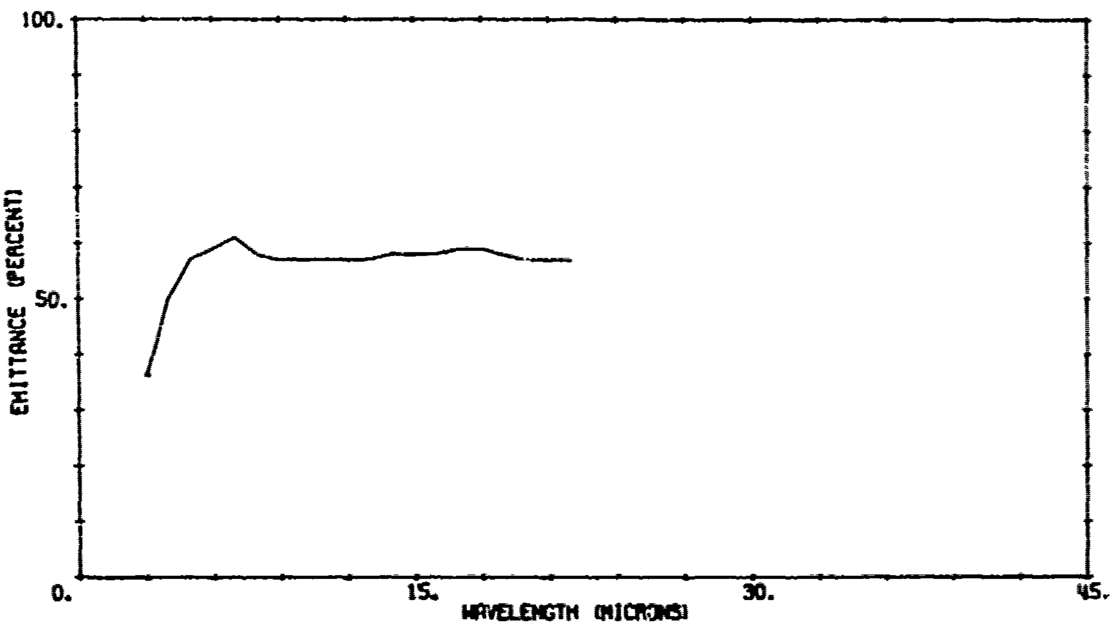
SECOND SURFACE MIRROR, AEROJET

θ_r = 50.0° T = 373°K



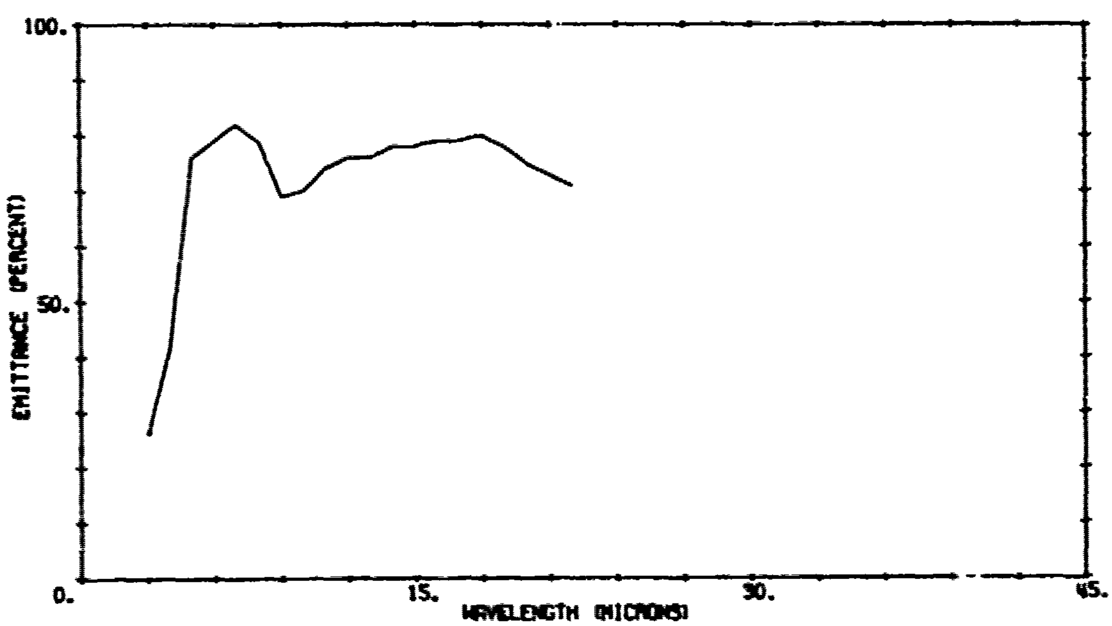
A03213 209

SECOND SURFACE MIRROR, AEROJET
θ_r = 80.0° T = 373°K



A03213 208

SECOND SURFACE MIRROR, AEROJET
θ_r = 70.0° T = 373°K

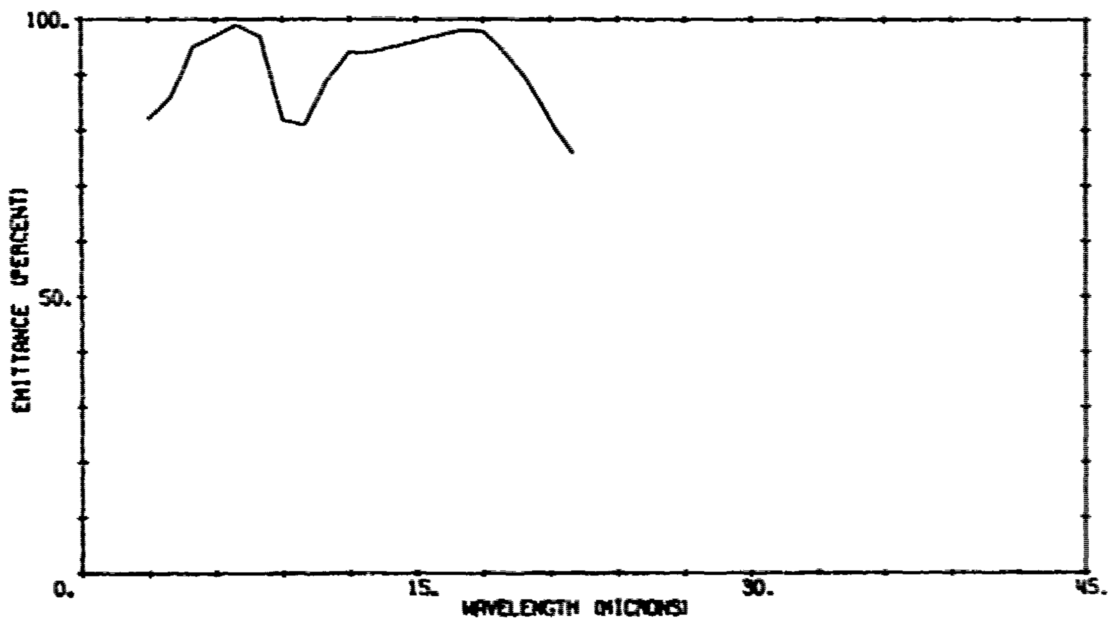


A03214 102

SOLAR CELL, AEROJET
$\theta_r = 10.0°$ $T = 200°K$

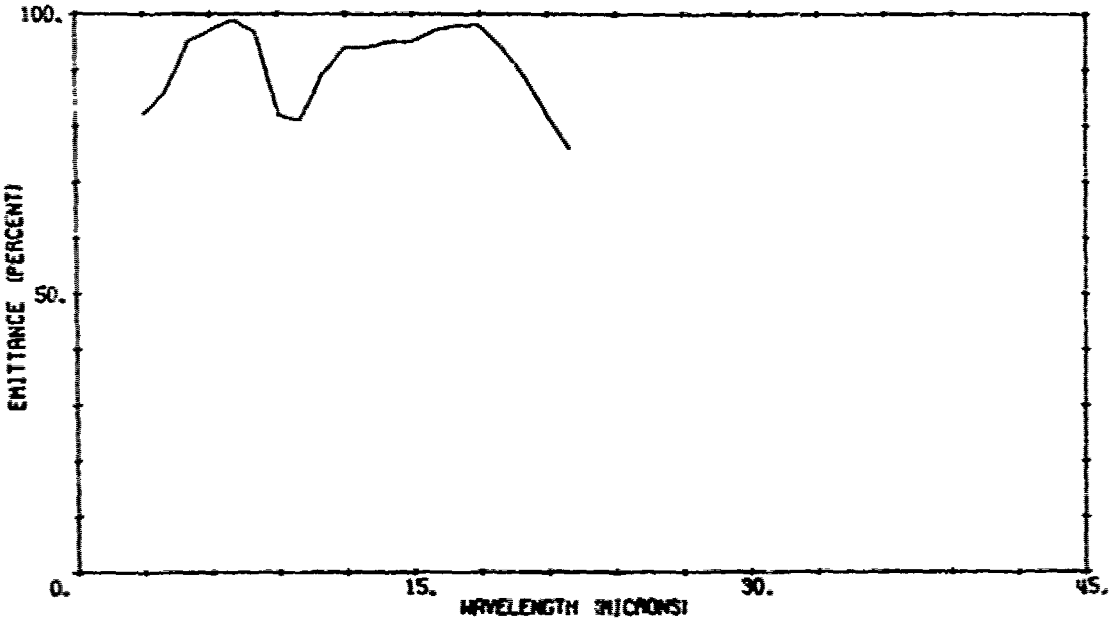
A03214 101

SOLAR CELL, AEROJET
$\theta_r = 0.0°$ $T = 200°K$



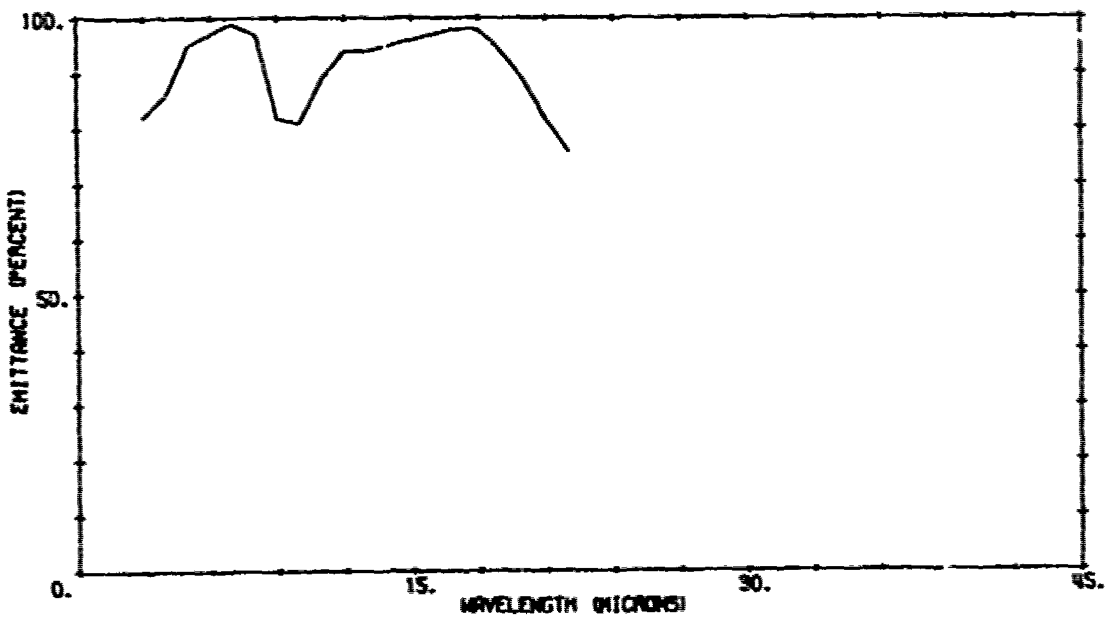
A03214 104

SOLAR CELL, AEROJET
$\theta_r = 30.0°$ $T = 200°K$



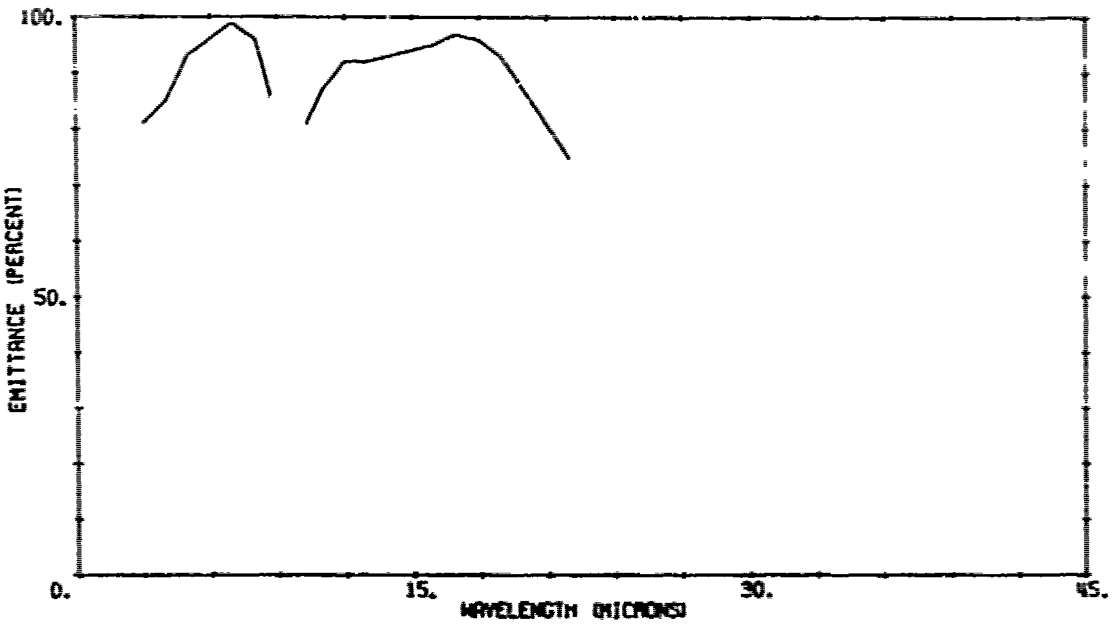
A03214 103

SOLAR CELL, AEROJET
$\theta_r = 30.0°$ $T = 300°K$



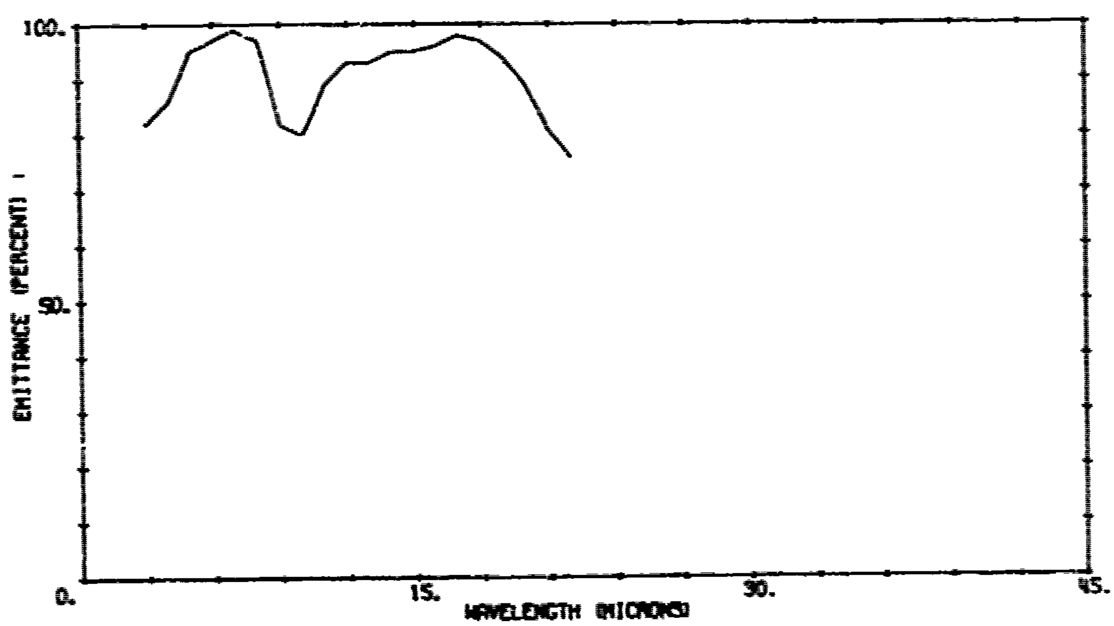
A03214 106

SOLAR CELL, AEROJET
$\theta_r = 50.0°$ $T = 200°K$



A03214 105

SOLAR CELL, AEROJET
$\theta_r = 40.0°$ $T = 200°K$

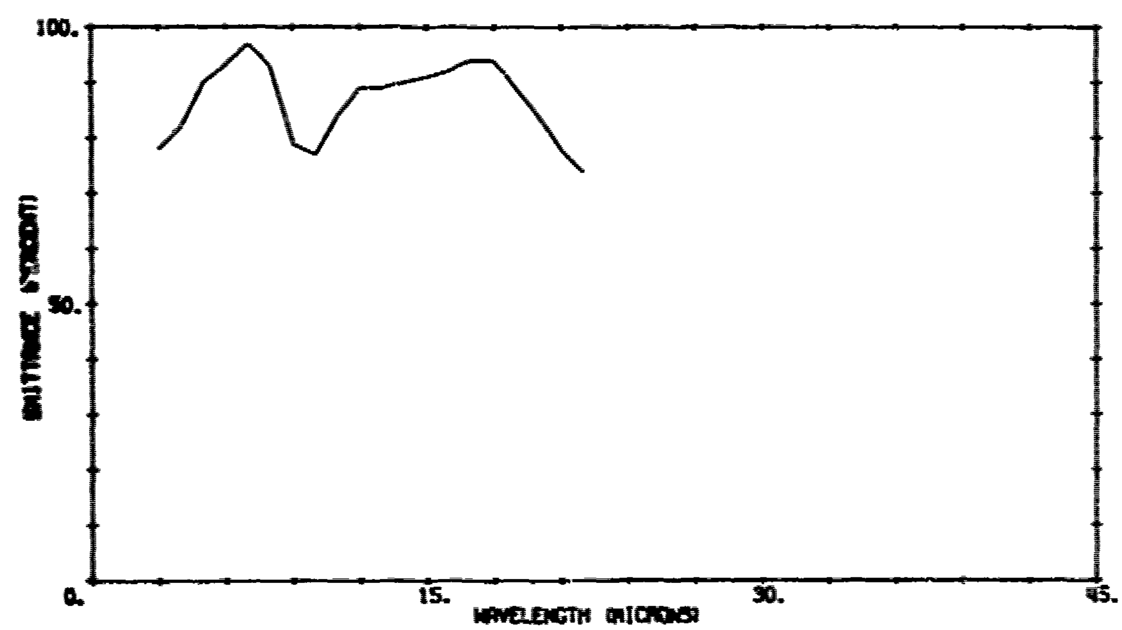


A03214 108

SOLAR CELL, AEROJET
θ_r = 70.0° T = 200°K

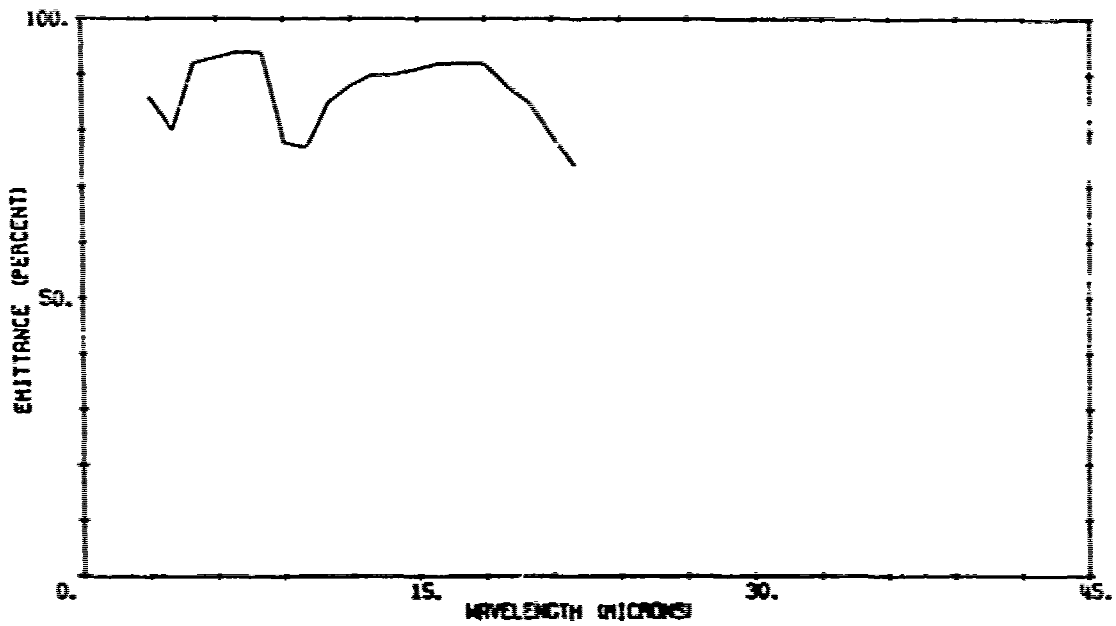
A03214 107

SOLAR CELL, AEROJET
θ_r = 60.0° T = 200°K



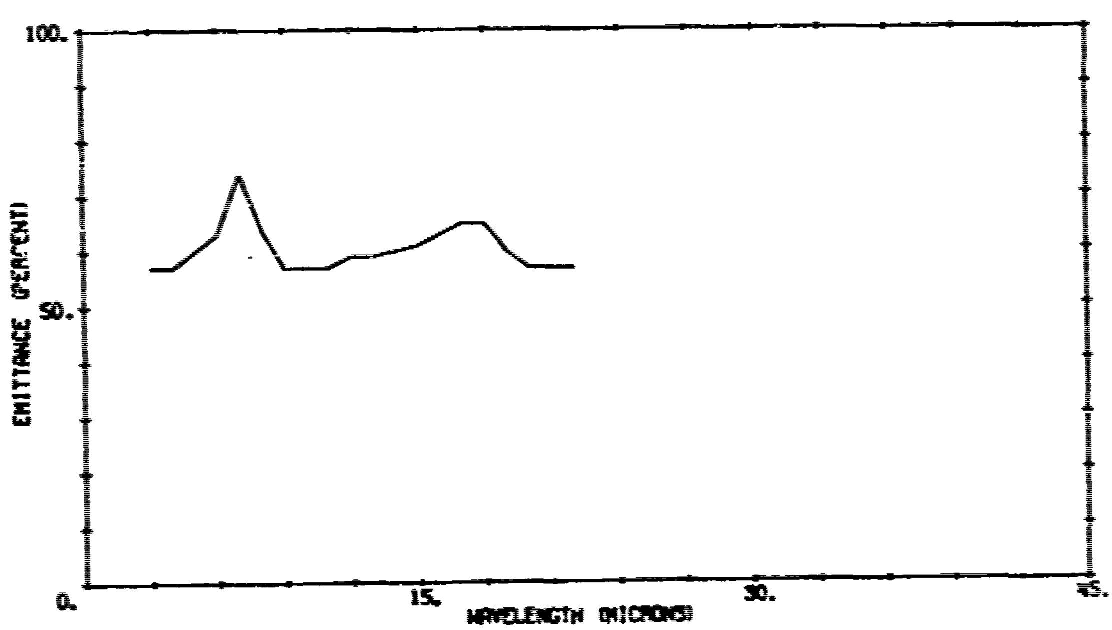
A03214 201

SOLAR CELL, AEROJET
$\theta_r = 0.0°$ T = 373°K



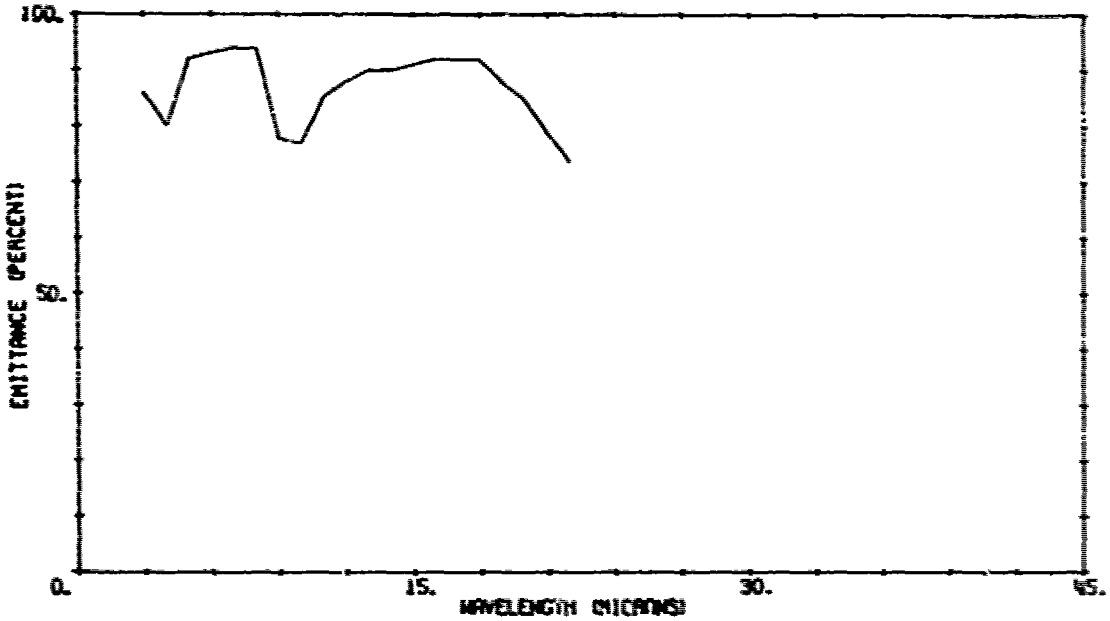
A03214 109

SOLAR CELL, AEROJET
$\theta_r = 80.0°$ T = 200°K



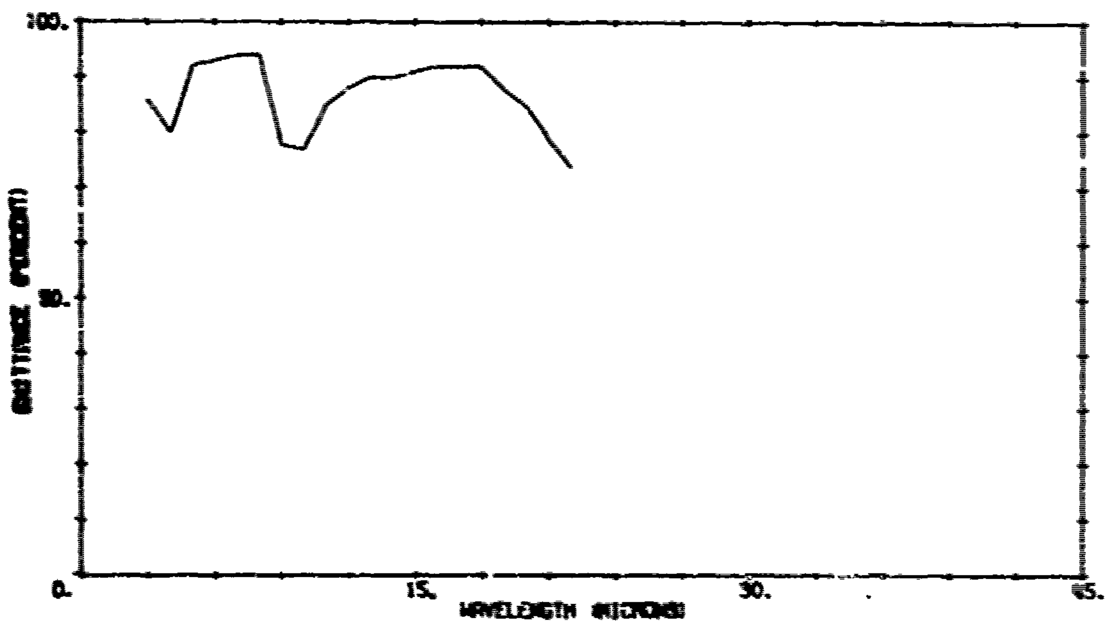
A03214 203

SOLAR CELL, AEROJET
$\theta_r = 20.0°$ T = 373°K



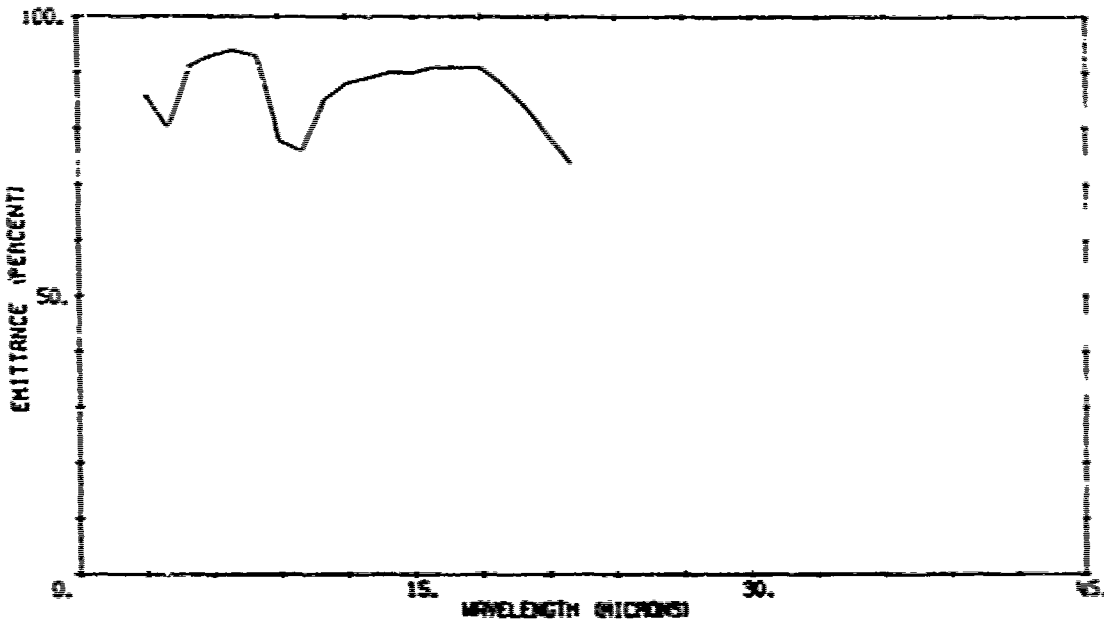
A03214 202

SOLAR CELL, AEROJET
$\theta_r = 10.0°$ T = 373°K



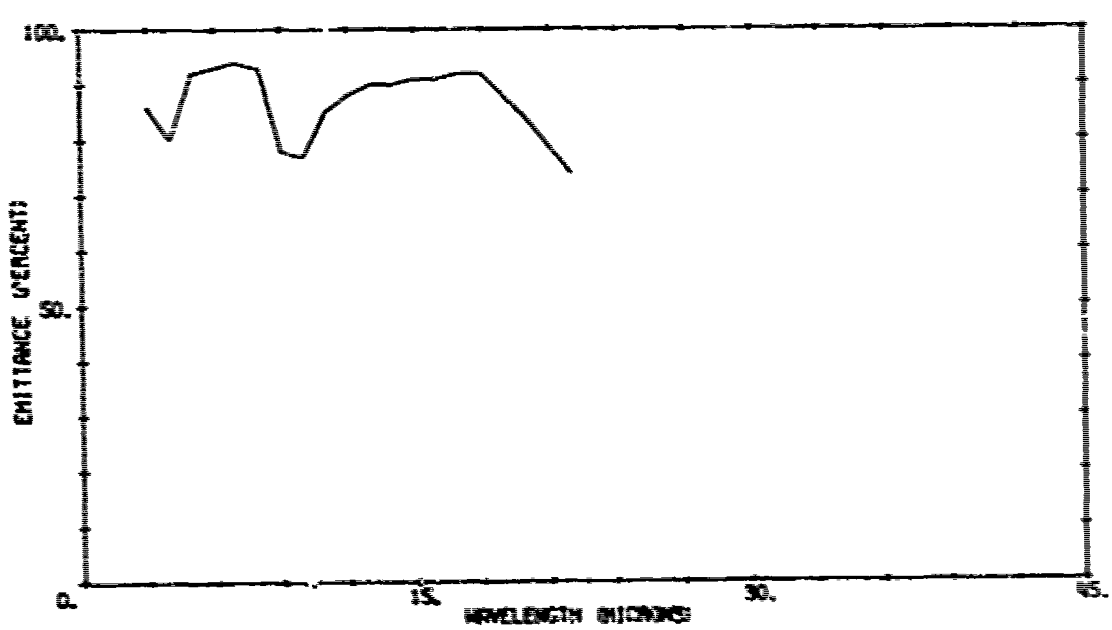
A03214 205

SOLAR CELL, AEROJET
$\theta_r = 40.0°$ $T = 373°K$



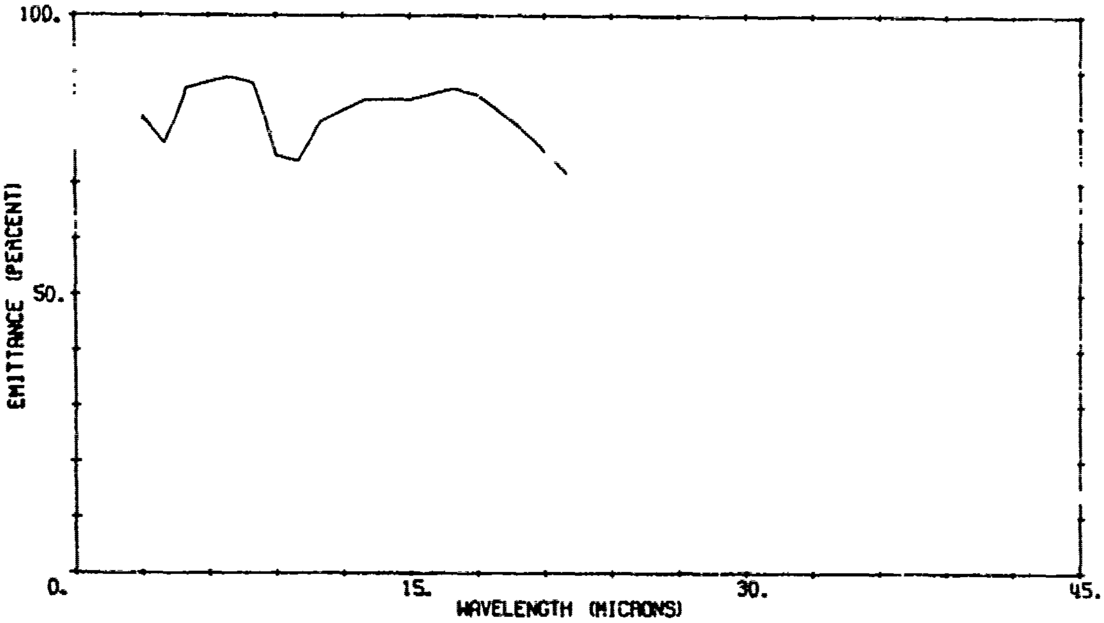
A03214 204

SOLAR CELL, AEROJET
$\theta_r = 30.0°$ $T = 373°K$



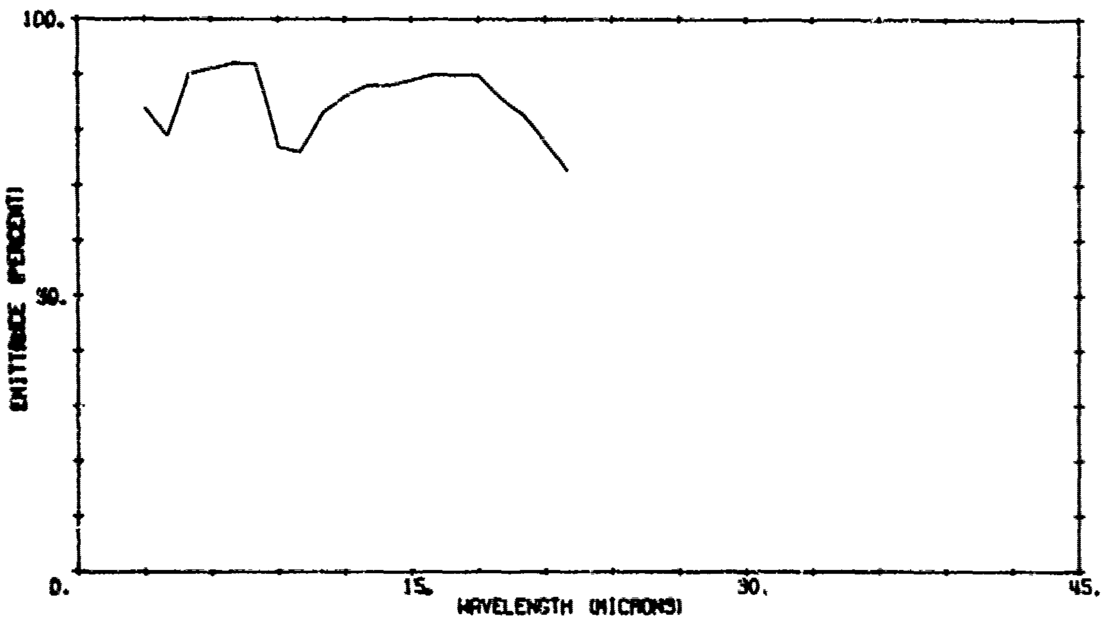
A03214 207

SOLAR CELL, AEROJET
$\theta_r = 60.0^o$ T = 373^oK



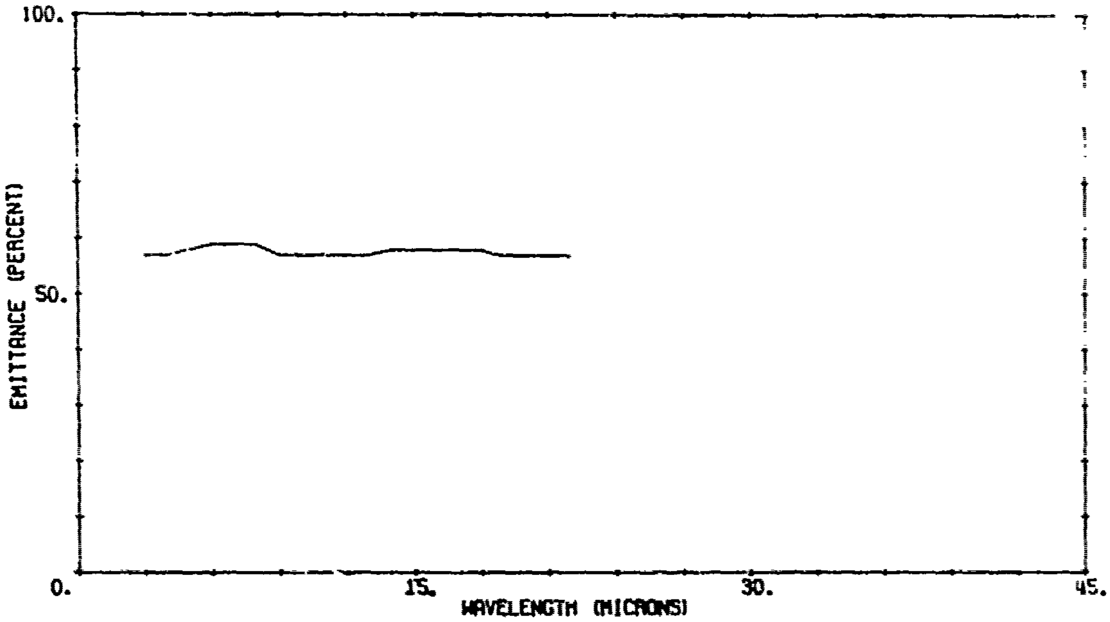
A03214 206

SOLAR CELL, AEROJET
$\theta_r = 50.0^o$ T = 373^oK



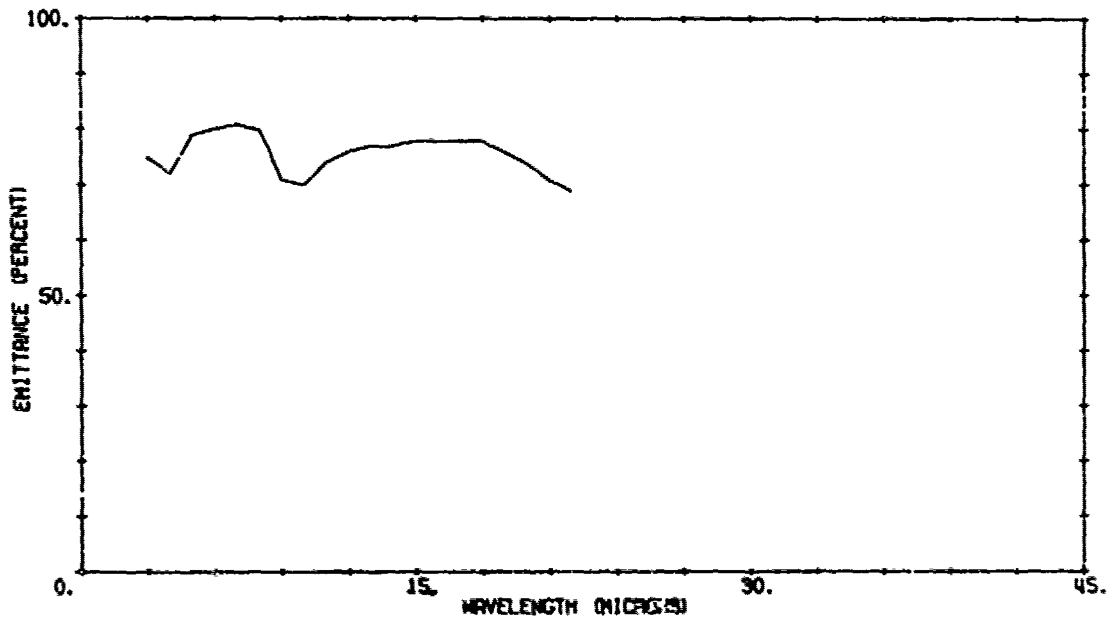
A03214 209

SOLAR CELL, AEROJET
$\theta_r = 80.0^\circ$ T = 373°K



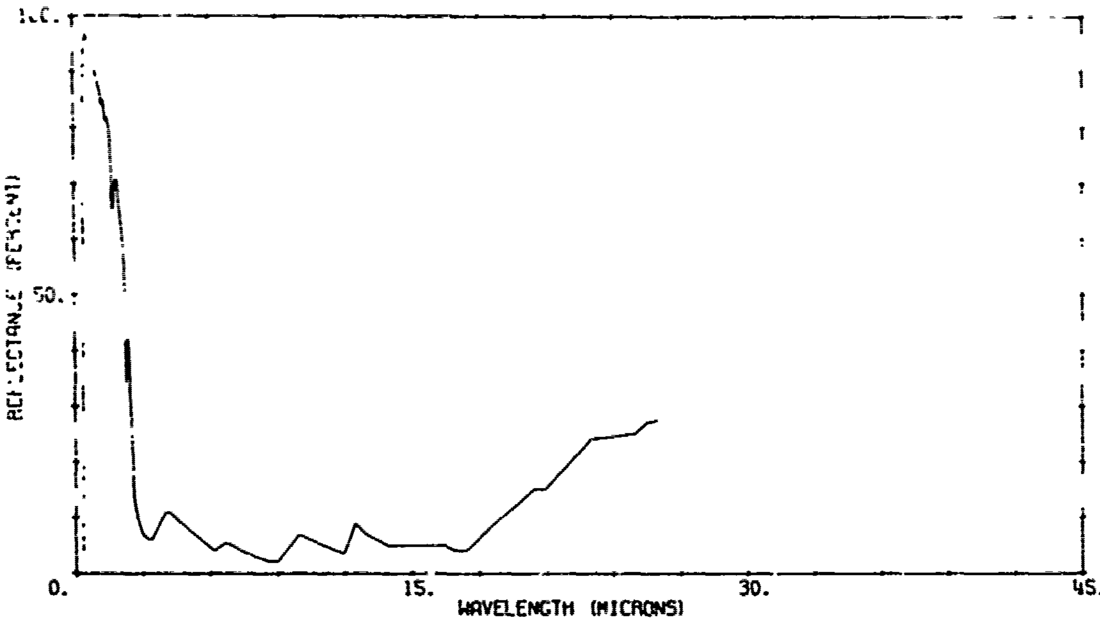
A03214 208

SOLAR CELL, AEROJET
$\theta_r = 70.0^\circ$ T = 373°K



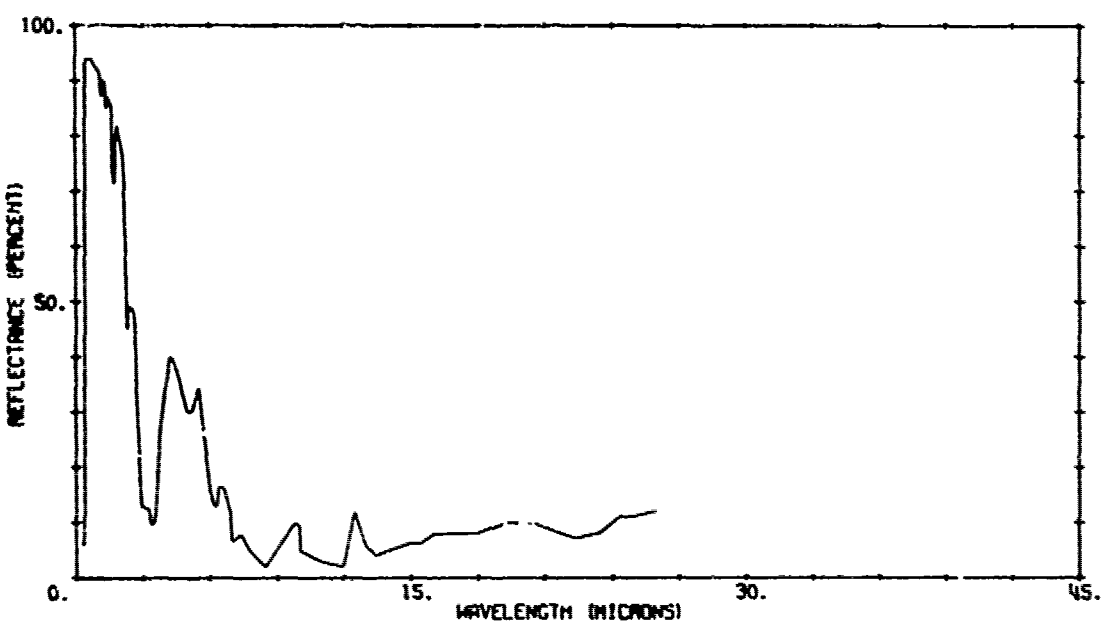
A03216 101 WHITE PAINT. DC S-13G

$\theta_r = 15.0°$



A03215 101 WHITE PAINT. DC 92-007

$\theta_r = 15.0°$



Appendix C
DIFFUSE BIDIRECTIONAL REFLECTANCE DATA

This appendix contains computer plots of all the diffuse bidirectional reflectance data taken during the AVCO and SAMSO measurement programs. Measurement samples were classified as being diffuse or specular, depending on the nature of the reflected radiation; however, the diffuse components of reflectance for both classifications are reported herein. For sample materials which exhibit significant specularity, the data presented near the specular position are low in value because of the instrument resolution used. Therefore, the data given in Appendix D complements this data by more accurately describing the spatial distribution and value of reflectance for the specular points. As such, both data from Appendix C and D should be used to describe those materials which are specular in nature.

The computer plots of ρ' are arranged two to a page with the abscissa displaying the zenith angle of the receiver, θ_r, and the ordinate displaying the bidirectional reflectance, ρ', on a logrithmic scale. Above each plot is the sample number—a four-digit number preceded by an AO. Following the sample number is a three-digit number in which the first digit denotes the area or cell being measured, while the second and third digits indicate the measurement condition (parameters).

Above each graphical presentation is a list of curve symbols and their descriptions. Following each curve symbol, descriptions are given showing the polarization relationship of the source and receiver. The polarization references for the source and receiver are defined by planes containing the sample normal and a central ray that extends from the base of the normal to the source and receiver, respectively.

The symbols used to show the polarization relationship between the E-vector of light and the reference plane are:

(1) $\parallel$ - E-vector parallel to reference plane
(2) $\perp$ - E-vector perpendicular to reference plane
(3) O - Source energy unpolarized
(4) T - Receiver unpolarized

The sequence of the polarization code is to always give first the source and then the receiver polarization. To illustrate: a curve symbol, +, followed by a $\parallel$, $\perp$, would show that this curve (marked +) has the source polarizer aligned such that the E-vector passed by the polarizer is parallel to the reference plane while the receiver's polarizer is aligned so that the E-vector is perpendicular to the reference plane. Other information at the top of the curve gives the wavelength (λ) at which measurements were made, the zenith angle (θ_i) of the source, and the azimuth angle (ϕ_i) of the source. It should be noted that the broadband measurements (0.4 to 0.7 μm) are designated by $\lambda = 0.55$ μm.

Examination of the abscissa may at first glance be confusing because the scale on the abscissa goes from 90^o to 0^o to 90^o; however, further examination of the lower part of the graph will show that there is a ϕ_r or receiver azimuth on the left and also one on the right. The line down the center of the graph splits the plot up into the two halves of a phi plane. Once this fact is noted, there shouldn't be any confusion in using the plots.

Prior to using the data contained in this appendix, the reader should be aware of two facts which may aid in interpretation of the data presented. The first item deals with the noise limitation of interpretation, and the second deals with the method by which signals having large dynamic ranges (> four orders magnitude) are plotted on a 4-cycle logarithm scale.

Interpretation of the noise limit can be best explained by illustration. For the data curves of Sample A03181-401 ($\theta_i = 0^o, 40^o$), the noise limit is readily observed. That part of the curve which rises gently upward as θ_r increases is the noise limit for this particular piece of data. This is identified by the small angle variability and the fact that the curve follows a secant theta function. These observations are usually indicative of having reached the noise limit of the system and suggest that the real reflectance lies somewhere below the value shown. The exact level at which the noise appears is a function of many of the measurement parameters and may vary greatly from curve to curve.

The curves for A03117-802 ($\theta_i = 30^o, 60^o$) illustrate the method used to handle large dynamic range signals. In this example the reflectances increase from a ρ' value of around 0.2 at an angle of 80 degrees, to a value of 10 at 30 degrees. Higher signals are displayed by moving them down two decades (i.e., $\rho' = 10$ is plotted as 0.1) and plotting the symbols without connecting lines for each curve folded over. In the illustration referenced, the symbols run together to form a very heavy line. Here the highest ρ' value shown is not 10, but 25. This fold-over of the curve enables one to display six logarithmic cycles on four cycles of paper.

A tabulation of the data appearing in this appendix immediately follows. Table C-1 gives sample and area condition numbers, description of the samples, and all the data needed to define a particular plot. All of the data shown is also available in the ERAS format either in cards or on magnetic tape from ERIM. The ERAS format is described in Appendix D.

TABLE C-1. SUMMARY OF DIFFUSE ρ' DATA CONTENTS

Description	Sample No.	Area No.	λ	θ_i	ϕ_i	ϕ_r
TRW 2nd Surface Mirror	3165	401	.63	.0	.0	.00 180.00
TRW 2nd Surface Mirror	3165	401	.63	40.0	.0	.00 180.00
TRW 2nd Surface Mirror	3165	402	.55	.0	180.0	.00 180.00
TRW 2nd Surface Mirror	3165	402	.55	40.0	180.0	.00 180.00
TRW 2nd Surface Mirror	3165	402	.55	40.0	180.0	90.00 270.00
TRW 2nd Surface Mirror	3165	403	1.06	.0	180.0	.00 180.00
TRW 2nd Surface Mirror	3165	403	1.06	40.0	180.0	.00 180.00
TRW 2nd Surface Mirror	3165	403	1.06	40.0	180.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	.0	180.0	.00 180.00
Aluminum Trim Tape	3177	601	.55	20.0	180.0	.00 180.00
Aluminum Trim Tape	3177	601	.55	40.0	180.0	.00 180.00
Aluminum Trim Tape	3177	601	.55	60.0	180.0	.00 180.00
Aluminum Trim Tape	3177	601	.55	20.0	180.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	40.0	180.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	60.0	180.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	.0	270.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	20.0	270.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	40.0	270.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	60.0	270.0	90.00 270.00
Aluminum Trim Tape	3177	601	.55	20.0	270.0	.00 180.00
Aluminum Trim Tape	3177	601	.55	40.0	270.0	.00 180.00
Aluminum Trim Tape	3177	601	.55	60.0	270.0	.00 180.00
Aluminum Trim Tape	3177	701	.63	.0	.0	.00 180.00
Aluminum Trim Tape	3177	701	.63	30.0	.0	.00 180.00
Aluminum Trim Tape	3177	701	.63	60.0	.0	.00 180.00

TABLE C-1. SUMMARY OF DIFFUSE ρ' DATA CONTENTS (Continued)

Description	Sample No.	Area No.	λ	θ_i	ϕ_i	ϕ_r
Aluminum Trim Tape	3177	702	.63	.0	90.0	90.00 270.00
Aluminum Trim Tape	3177	702	.63	30.0	90.0	90.00 270.00
Aluminum Trim Tape	3177	702	.63	60.0	90.0	90.00 270.00
Aluminum Trim Tape	3177	801	1.06	.0	.0	.00 180.00
Aluminum Trim Tape	3177	801	1.06	30.0	.0	.00 180.00
Aluminum Trim Tape	3177	801	1.06	60.0	.0	.00 180.00
Aluminum Trim Tape	3177	802	1.06	.0	90.0	90.00 270.00
Aluminum Trim Tape	3177	802	1.06	30.0	90.0	90.00 270.00
Aluminum Trim Tape	3177	802	1.06	60.0	90.0	90.00 270.00
Solar Cell Array, H-Type	3179	401	.55	.0	180.0	.00 180.00
Solar Cell Array, H-Type	3179	401	.55	40.0	180.0	.00 180.00
Solar Cell Array, H-Type	3179	401	.55	40.0	180.0	90.00 270.00
Solar Cell Array, H-Type	3179	401	.55	40.0	180.0	90.00 270.00
Solar Cell Array, C-Type	3181	401	.55	.0	180.0	.00 180.00
Solar Cell Array, C-Type	3181	401	.55	40.0	180.0	.00 160.00
Solar Cell Array, C-Type	3181	401	.55	40.0	180.0	90.00 270.00
Solar Cell Array, H-Type	3182	701	.63	.0	.0	.00 180.00
Solar Cell Array, H-Type	3182	701	.63	40.0	.0	.00 180.00
Solar Cell Array, H-Type	3182	702	.55	.0	180.0	.00 180.00
Solar Cell Array, H-Type	3182	702	.55	40.0	180.0	.00 180.00
Solar Cell Array, H-Type	3182	702	.55	40.0	180.0	90.00 270.00
Solar Cell Array, H-Type	3182	704	1.06	.0	180.0	.00 180.00
Solar Cell Array, H-Type	3182	704	1.06	40.0	180.0	.00 180.00
Solar Cell Array, H-Type	3182	704	1.06	40.0	180.0	90.00 270.00

TABLE C-1. SUMMARY OF DIFFUSE ρ' DATA CONTENTS (Continued)

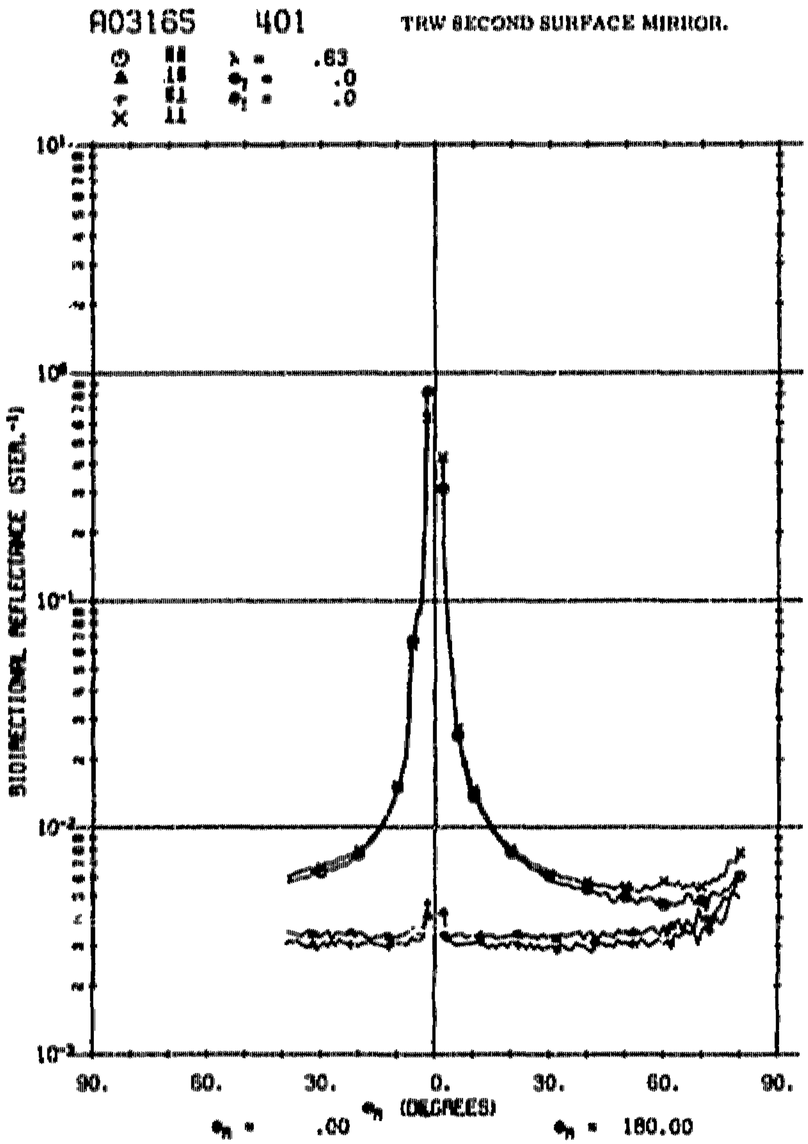
Description	Sample No.	Area No.	λ	θ_i	ϕ_i	ϕ_r
Solar Cell Array, H-Type	3183	401	.55	.0	180.0	.00 180.00
Solar Cell Array, H-Type	3183	401	.55	40.0	180.0	.00 180.00
Solar Cell Array, H-Type	3183	401	.55	40.0	180.0	90.00 270.00
Solar Cell Array, C-Type	3184	801	.63	.0	180.0	.00 130.00
Solar Cell Array, C-Type	3164	801	.63	40.0	180.0	.00 180.00
Solar Cell Array, C-Type	3184	802	.63	.0	90.0	90.00 270.00
Solar Cell Array, C-Type	3184	802	.63	40.0	90.0	90.00 270.00
Solar Cell Array C-Type	3184	803	.55	.0	180.0	.00 180.00
Solar Cell Array, C-Type	3184	803	.55	40.0	180.0	.00 180.00
Solar Cell Array, C-Type	3184	804	1.06	.0	180.0	.00 180.00
Solar Cell Array, C-Type	3164	804	1.06	40.0	180.0	.00 180.00
Solar Cell Array, C-Type	3184	804	1.06	40.0	180.0	90.00 270.00
Solar Cell Array, C-Type	3185	401	.55	.0	180.0	.00 180.00
Solar Cell Array C-Type	3185	401	.55	40.0	180.0	.00 180.00
Solar Cell Array C-Type	3185	401	.55	40.0	180.0	90.00 270.00
Aerojet 2nd Surface Mirror Array	3190	701	.63	.0	180.0	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	701	.63	40.0	180.0	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	702	.55	.0	180.0	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	702	.55	40.0	180.0	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	702	.55	40.0	180.0	90.00 270.00
Aerojet 2nd Surface Mirror Array	3190	703	1.06	.0	180.0	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	703	1.06	40.0	180.00	.00 180.00
Aerojet 2nd Surface Mirror Array	3194	401	.55	40.0	180.00	90.00 270.00
Aerojet 2nd Surface Mirror Array	3194	401	.55	.0	180.0	.00 130.00

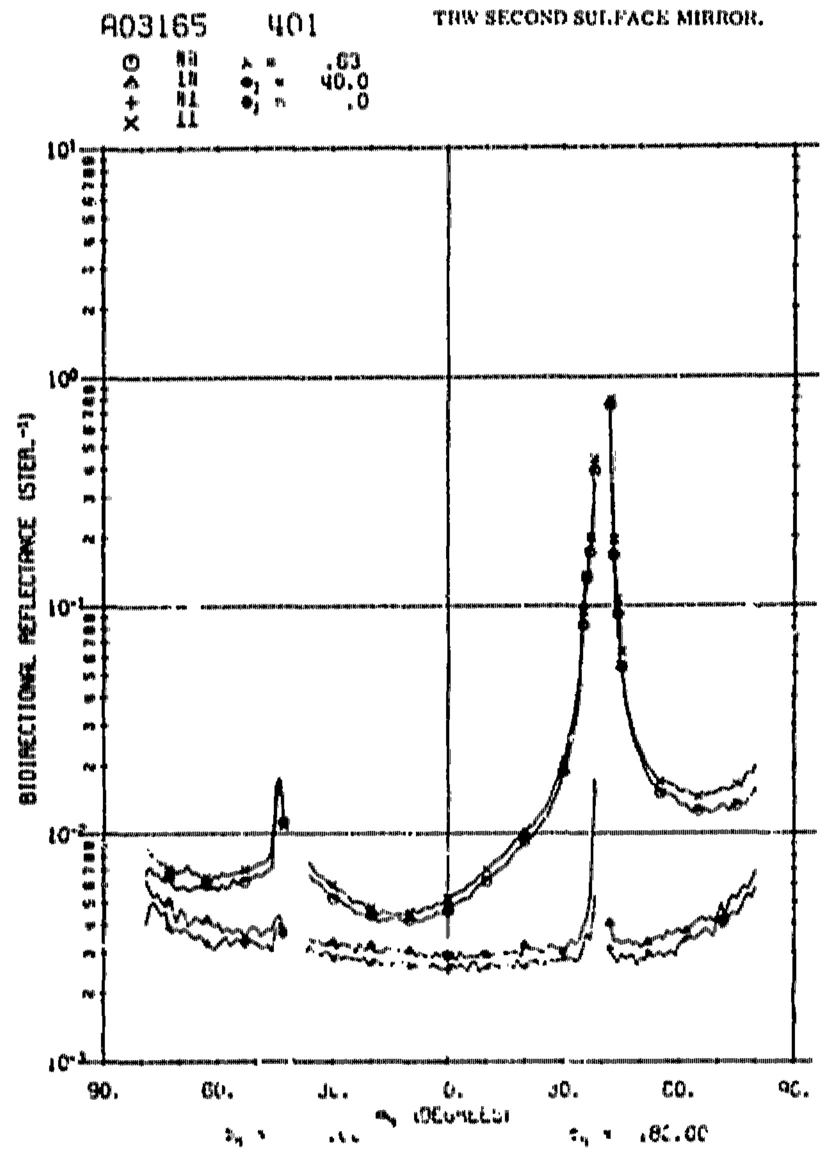
TABLE C-1. SUMMARY OF DIFFUSE ρ' DATA CONTENTS (Continued)

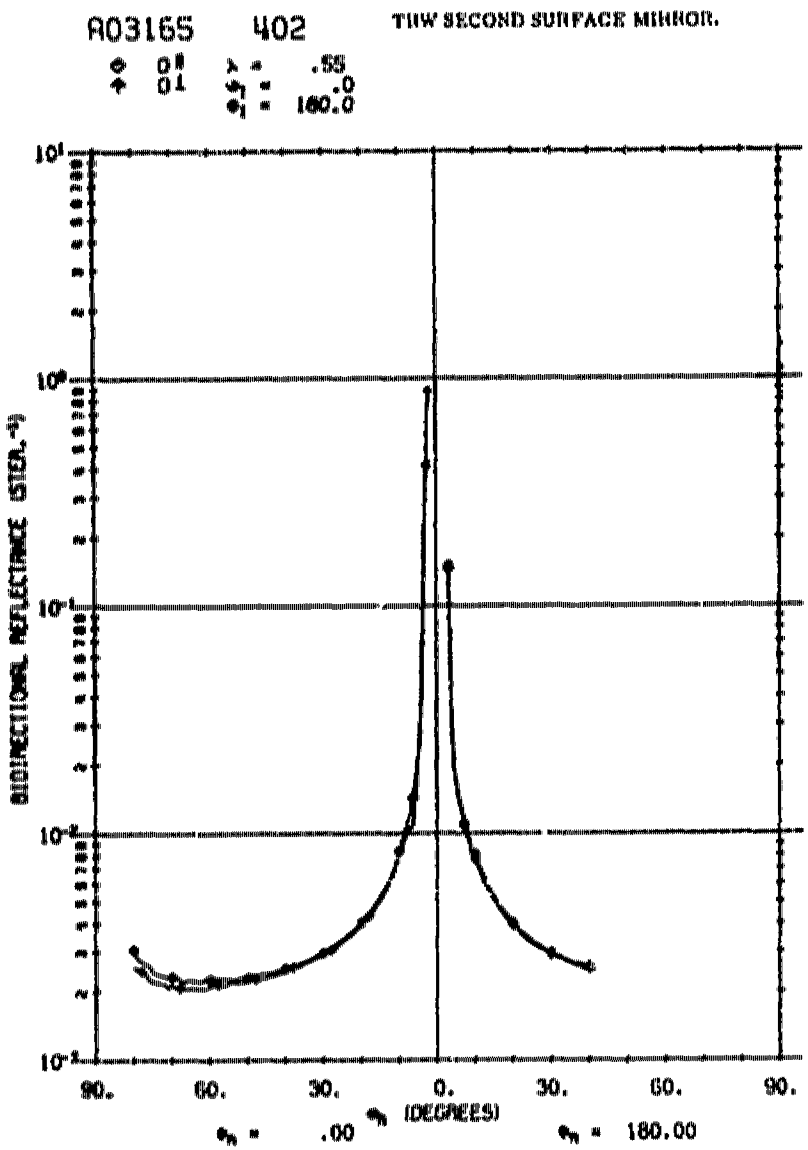
Description	Sample No.	Area No.	λ	θ_i	ϕ_i	ϕ_r
Aerojet 2nd Surface Mirror Array	3194	401	.55	40.0	180.0	.00 180.00
3M Black Velvet Paint, 101-C10	3197	401	.55	.0	180.0	.00 180.00
3M Black Velvet Paint, 101-C10	3197	401	.55	20.0	180.0	.00 180.00
3M Black Velvet Paint, 101-C10	3197	401	.55	40.0	180.0	.00 180.00
3M Black Velvet Paint, 101-C10	3197	401	.55	60.0	180.0	.00 180.00
3M Black Velvet Paint, 101-C10	3197	401	.55	.0	180.0	90.00 270.00
3M Black Velvet Paint, 101-C10	3197	401	.55	20.0	180.0	90.00 270.00
3M Black Velvet Paint, 101-C10	3197	401	.55	40.0	180.0	90.00 270.00
3M Black Velvet Paint, 101-C10	3197	401	.55	60.0	180.0	90.00 270.00
Aerojet White Paint	3206	401	.55	.0	180.0	.00 180.00
Aerojet White Paint	3206	401	.55	20.0	180.0	.00 180.00
Aerojet White Paint	3206	401	.55	40.0	180.0	.00 180.00
Aerojet White Paint	3206	401	.55	60.0	180.0	.00 180.00
Aerojet White Paint	3206	401	.55	20.0	180.0	90.00 270.00
Aerojet White Paint	3206	401	.55	40.0	180.0	90.00 270.00
Aerojet White Paint	3206	401	.55	60.0	180.0	90.00 270.00
Aerojet White Paint	3207	401	.63	.0	180.0	.00 180.00
Aerojet White Paint	3207	401	.63	20.0	180.0	.00 180.00
Aerojet White Paint	3207	401	.63	40.0	180.0	.00 180.00
Aerojet White Paint	3207	401	.63	60.0	180.0	.00 180.00
Aerojet White Paint	3207	401	.63	75.0	180.0	.00 180.00
Aerojet White Paint	3207	401	.63	20.0	180.0	90.00 270.00
Aerojet White Paint	3207	401	.63	40.0	180.0	90.00 270.00
Aerojet White Paint	3207	401	.63	60.0	180.0	90.00 270.00
Aerojet White Paint	3207	402	.55	.0	180.0	.00 180.00

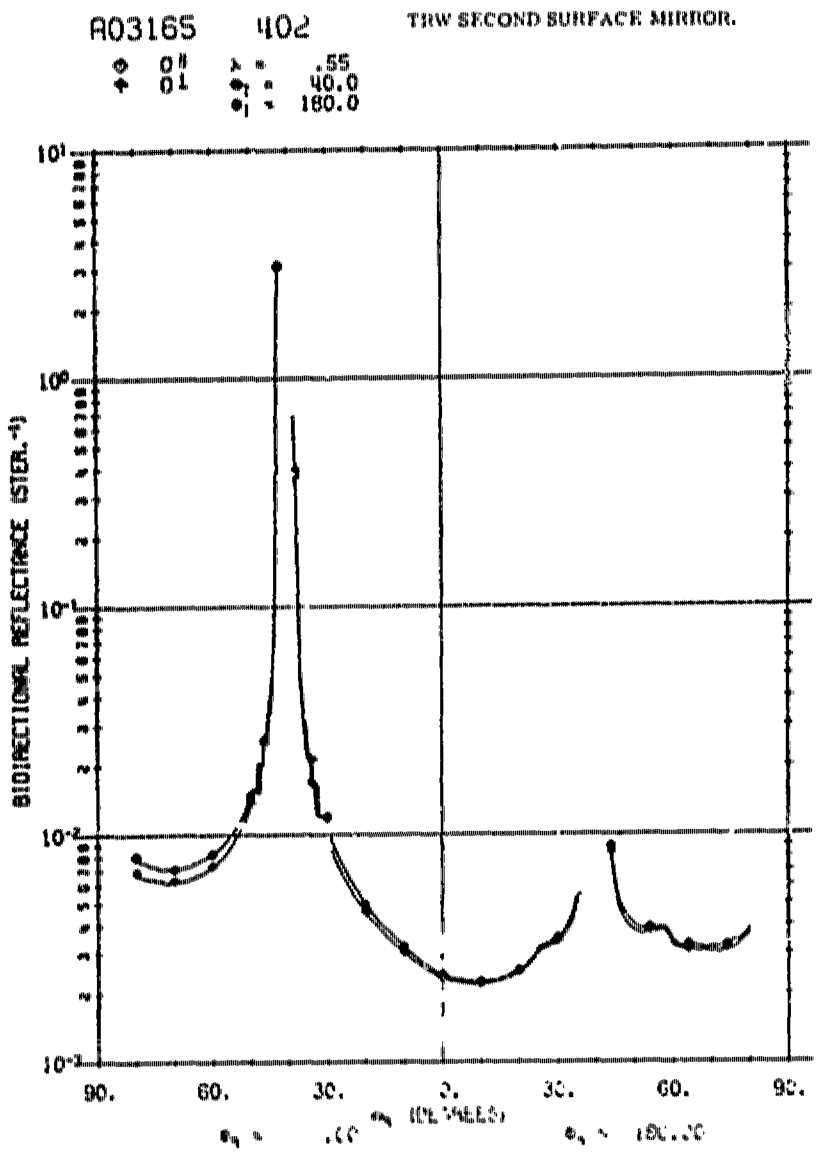
TABLE C-1. SUMMARY OF DIFFUSE ρ' DATA CONTENTS (Concluded)

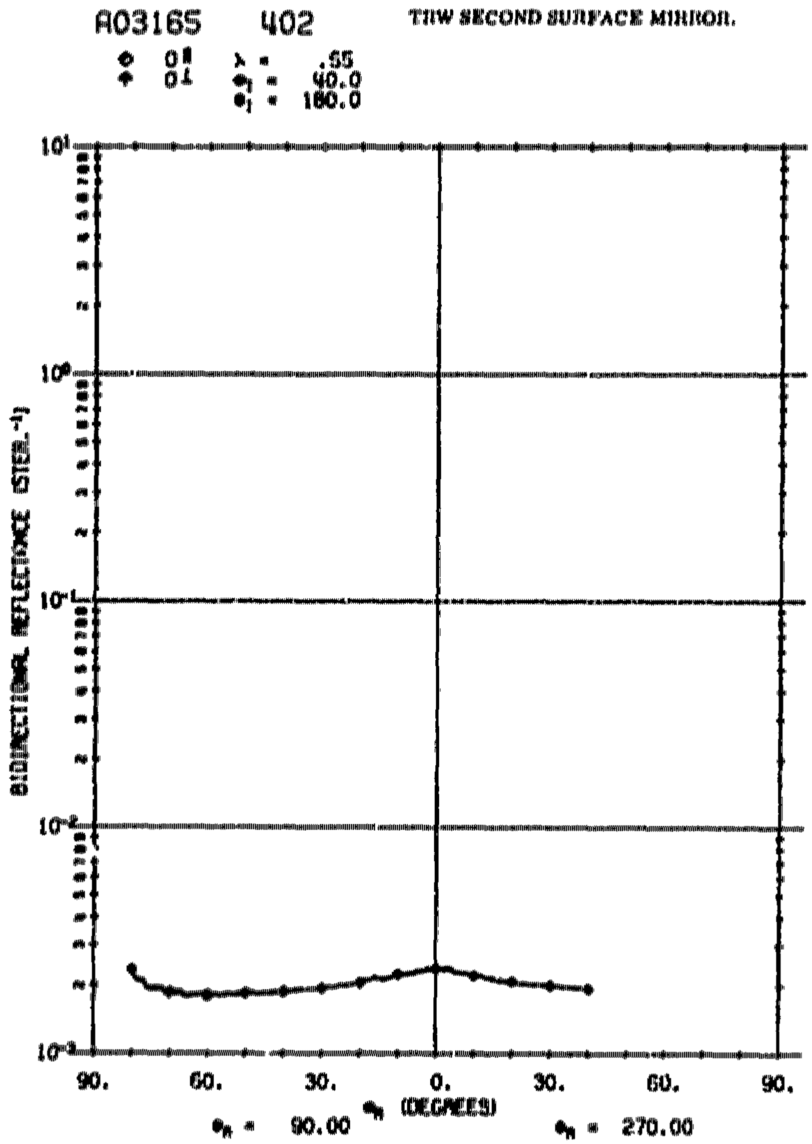
Description	Sample No.	Area No.	λ	θ_i	ϕ_i	ϕ_r
Aerojet White Paint	3207	402	.55	20.0	180.0	.00 180.00
Aerojet White Paint	3207	402	.55	40.0	180.0	.00 180.00
Aerojet White Paint	3207	402	.55	60.0	180.0	.00 180.00
Aerojet White Paint	3207	402	.55	75.0	180.0	.00 180.00
Aerojet White Paint	3207	402	.55	20.0	180.0	90.00 270.00
Aerojet White Paint	3207	402	.55	40.0	180.0	90.00 270.00
Aerojet White Paint	3207	402	.55	60.0	180.0	90.00 270.0
Aerojet White Paint	3207	403	1.06	.0	180.0	.00 180.00
Aerojet White Paint	3207	403	1.06	20.0	180.0	.00 180.00
Aerojet White Paint	3207	403	1.06	40.0	180.0	.00 180.00
Aerojet White Paint	3207	403	1.06	60.0	180.0	.00 180.00
Aerojet White Paint	3207	403	1.06	20.0	180.0	90.00 270.00
Aerojet White Paint	3207	403	1.06	40.0	180.0	90.00 270.00
Aerojet White Paint	3207	403	1.06	60.0	180.0	90.00 270.00
Aerojet White Paint	3207	403	1.06	75.0	180.0	.00 180.00
Aerojet White Paint	3207	403	1.06	75.0	180.0	90.00 270.00

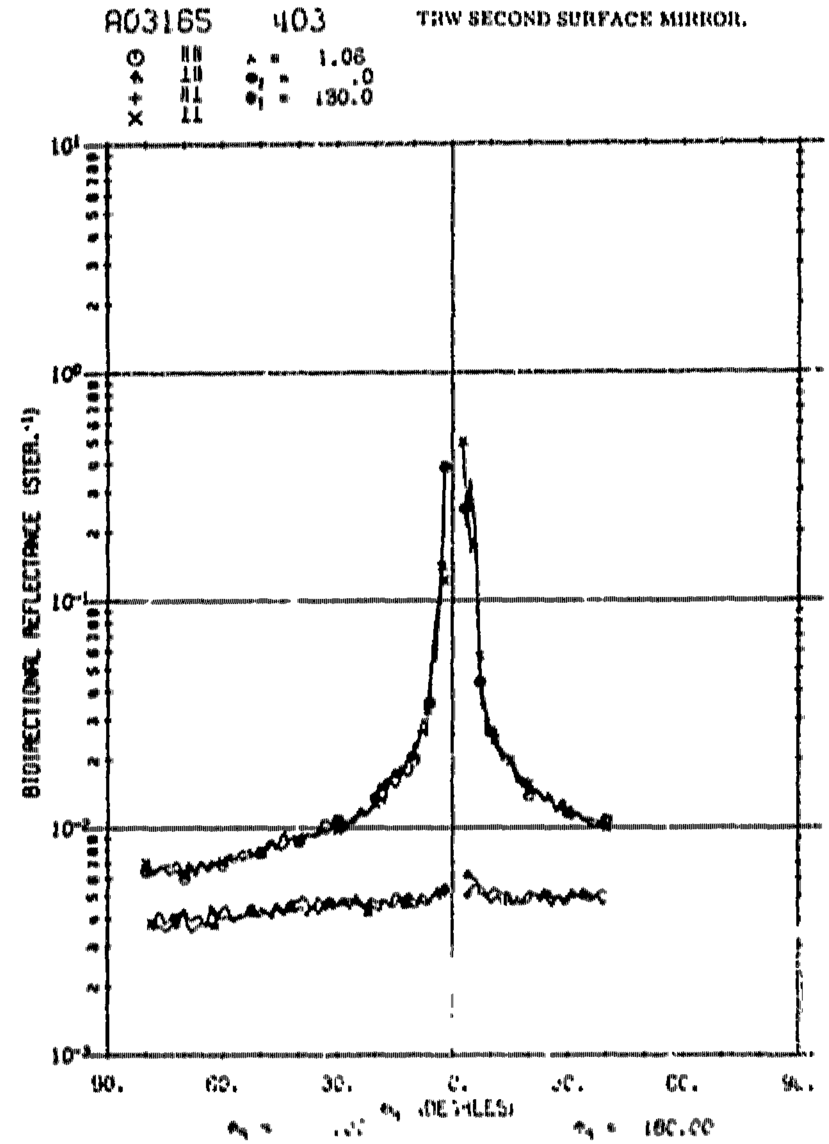

A03165 401
TRW SECOND SURFACE MIRROR.
λ = .63
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
(DEGREES)
.00
180.00

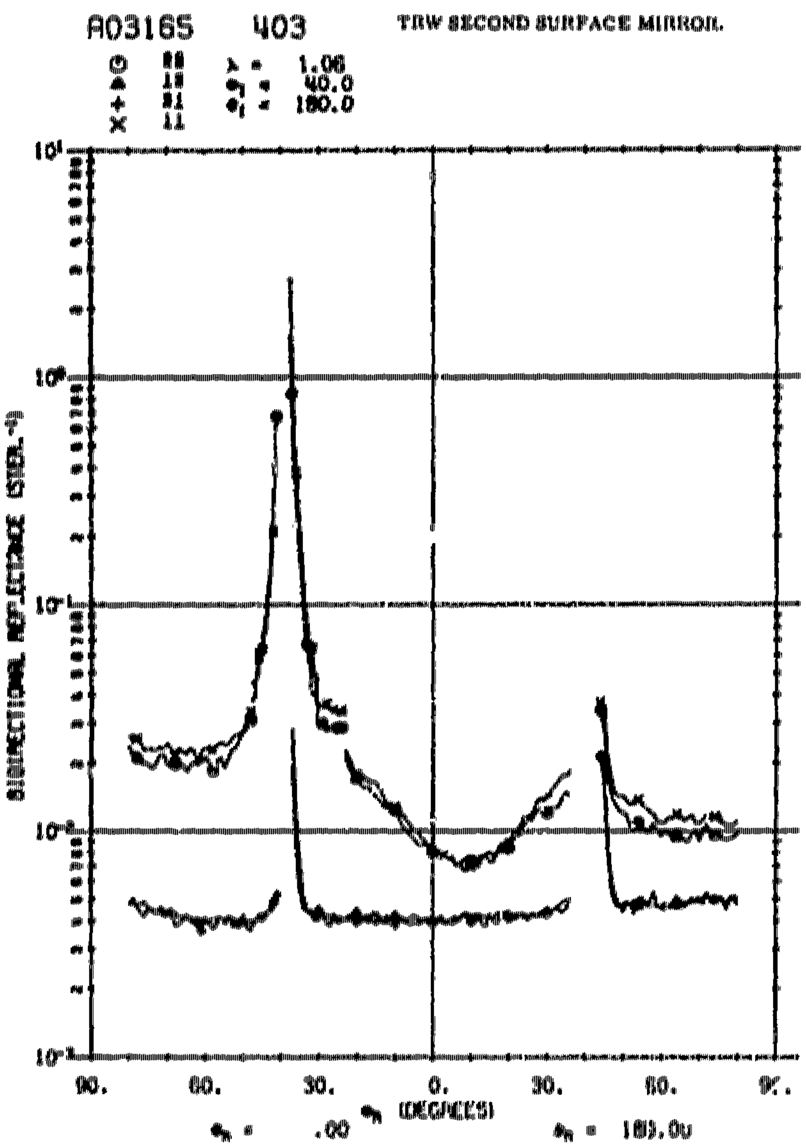

A03165 401
TRW SECOND SURFACE MIRROR.
λ = .63
40.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)

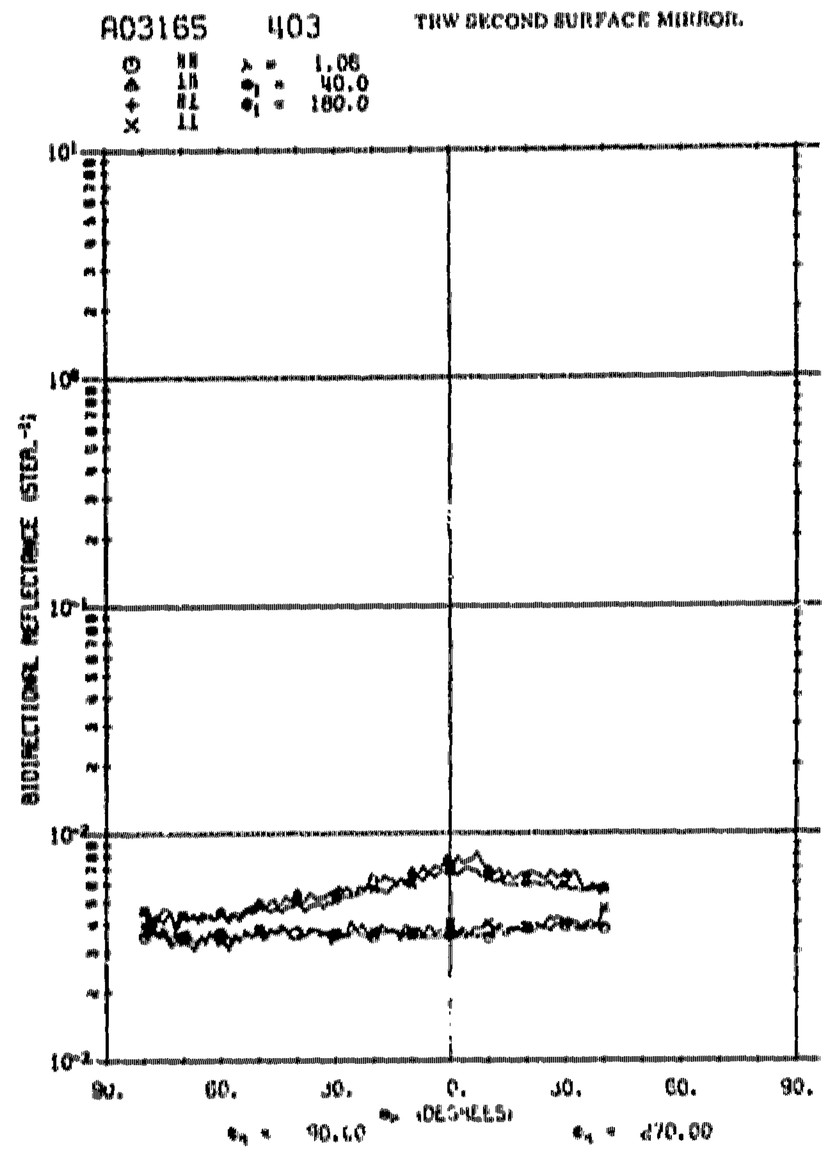

A03165 402
THW SECOND SURFACE MIRROR.
0∥
0⊥
λ = .55
θ_i = .0
φ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
10¹
10⁰
10⁻¹
10⁻²
10⁻³
90.
60.
30.
0.
30.
60.
90.
θ_R (DEGREES)
φ_R = .00
φ_R = 180.00

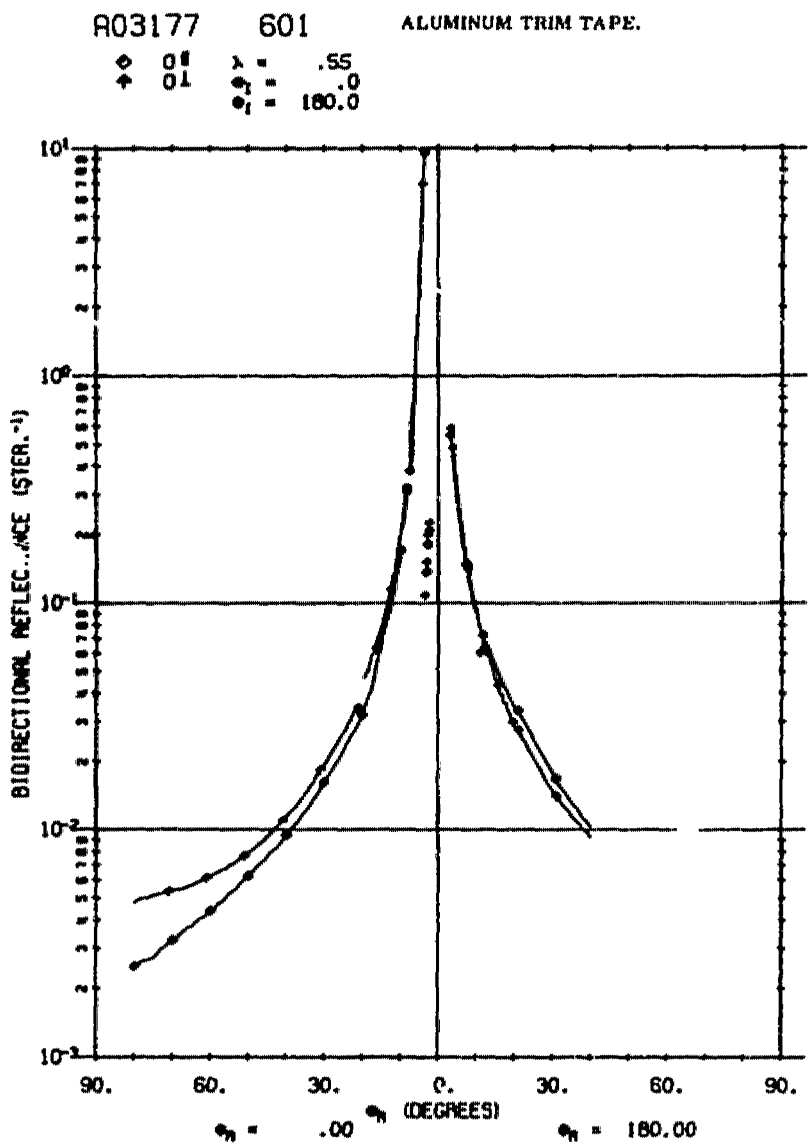

A03165 402
THW SECOND SURFACE MIRROR.
0∥
0⊥
λ = .55
θ_i = 40.0
φ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
10¹
10⁰
10⁻¹
10⁻²
10⁻³
90.
60.
30.
60.
90.


A03165 402
TRW SECOND SURFACE MIRROR.
λ = .55
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
10^1
10^0
10^-1
10^-2
10^-3
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = 90.00
φR = 270.00

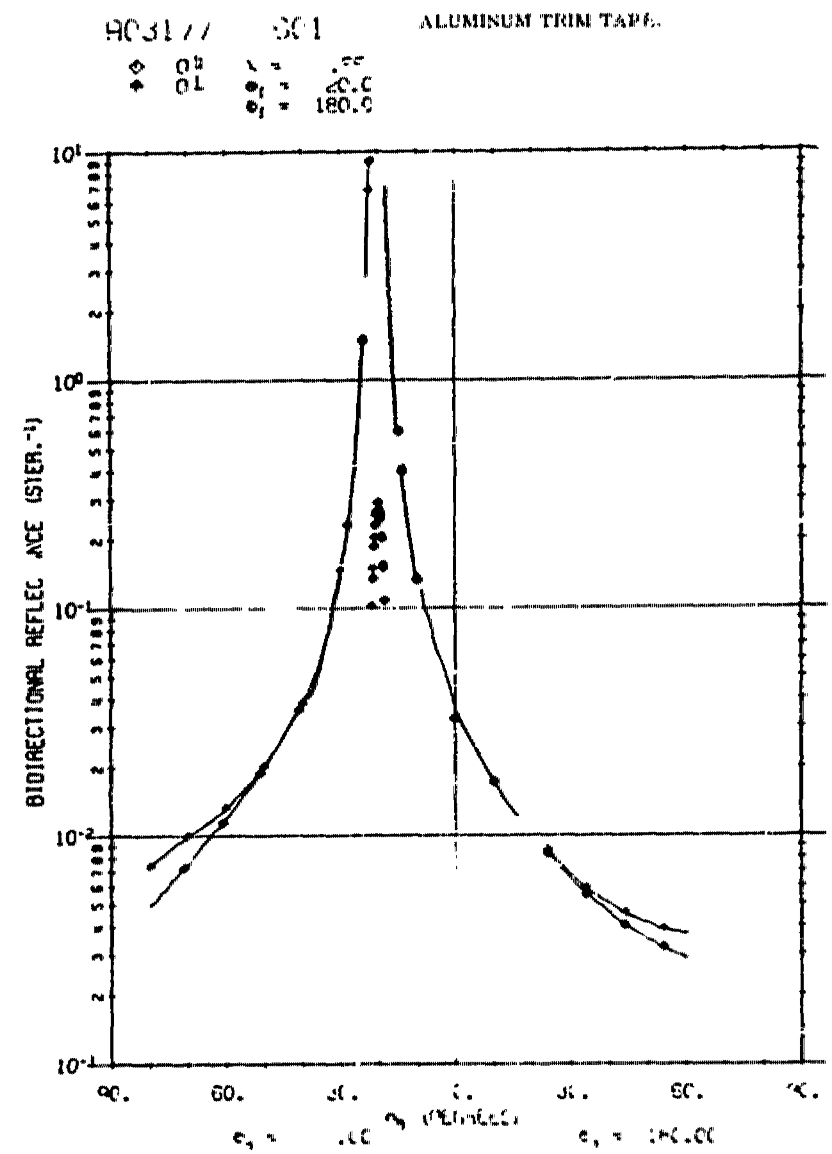

A03165 403
TRW SECOND SURFACE MIRROR.
λ = 1.06
θi = .0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
10^1
10^0
10^-1
10^-2
10^-3
90. 60. 30.
φR = 180.00


A03165 403
TRW SECOND SURFACE MIRROR.
⊙ RR
▲ IR
+ RI
X II
λ = 1.06
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.^-1)
θR (DEGREES)
φR = .00
φR = 180.00

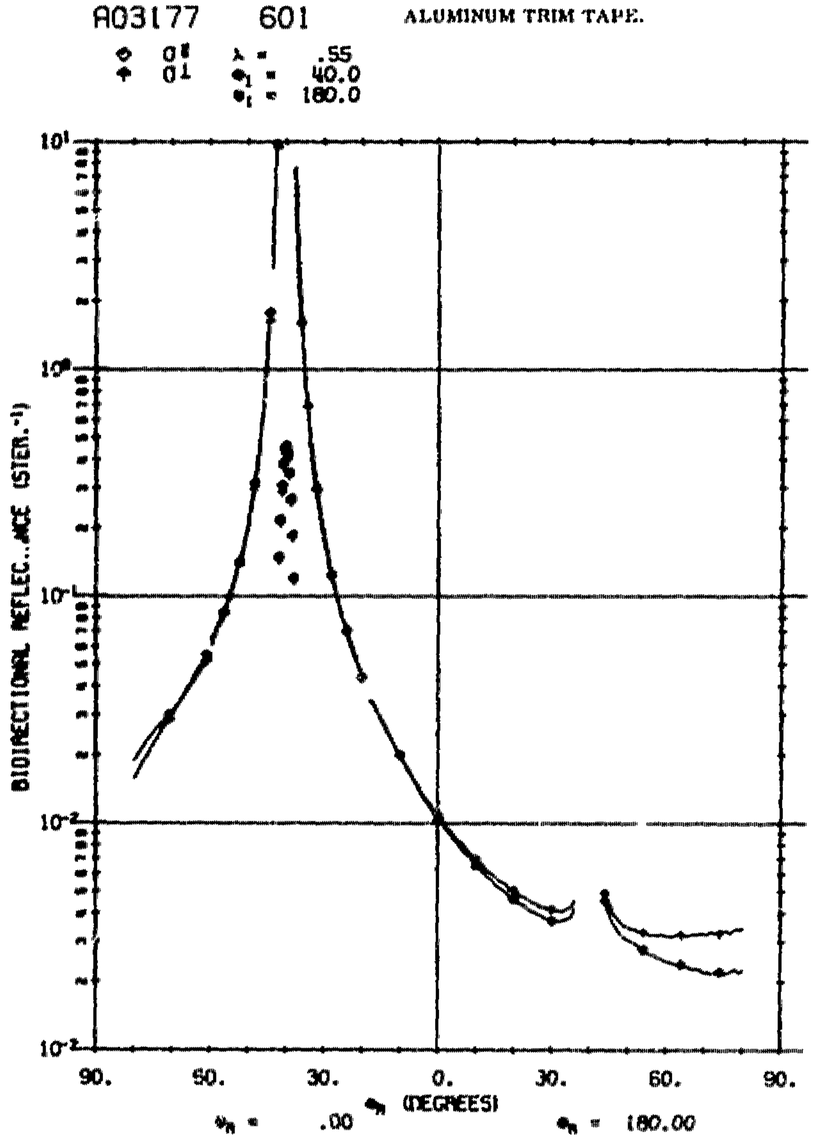

A03165 403
TRW SECOND SURFACE MIRROR.
⊙ RR
▲ IR
+ RI
X II
λ = 1.06
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.^-1)
θR (DEGREES)
φR = 90.00
φR = 270.00

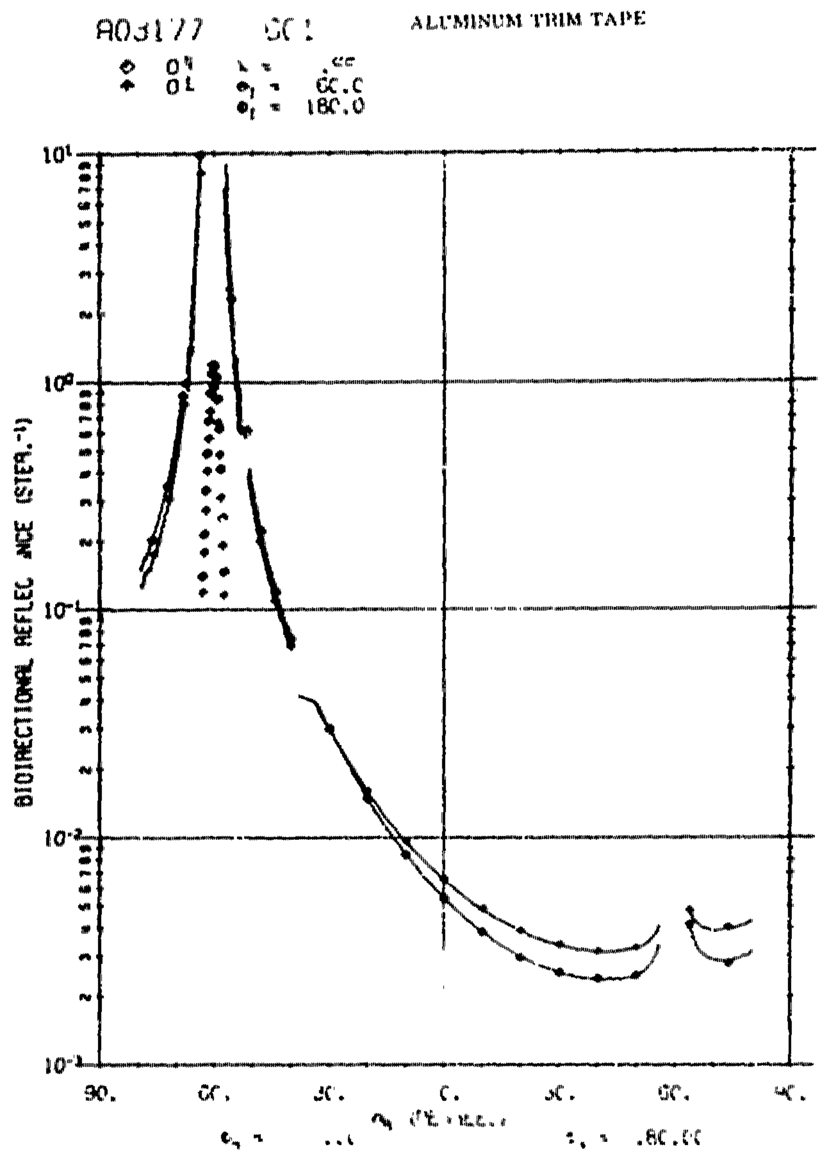


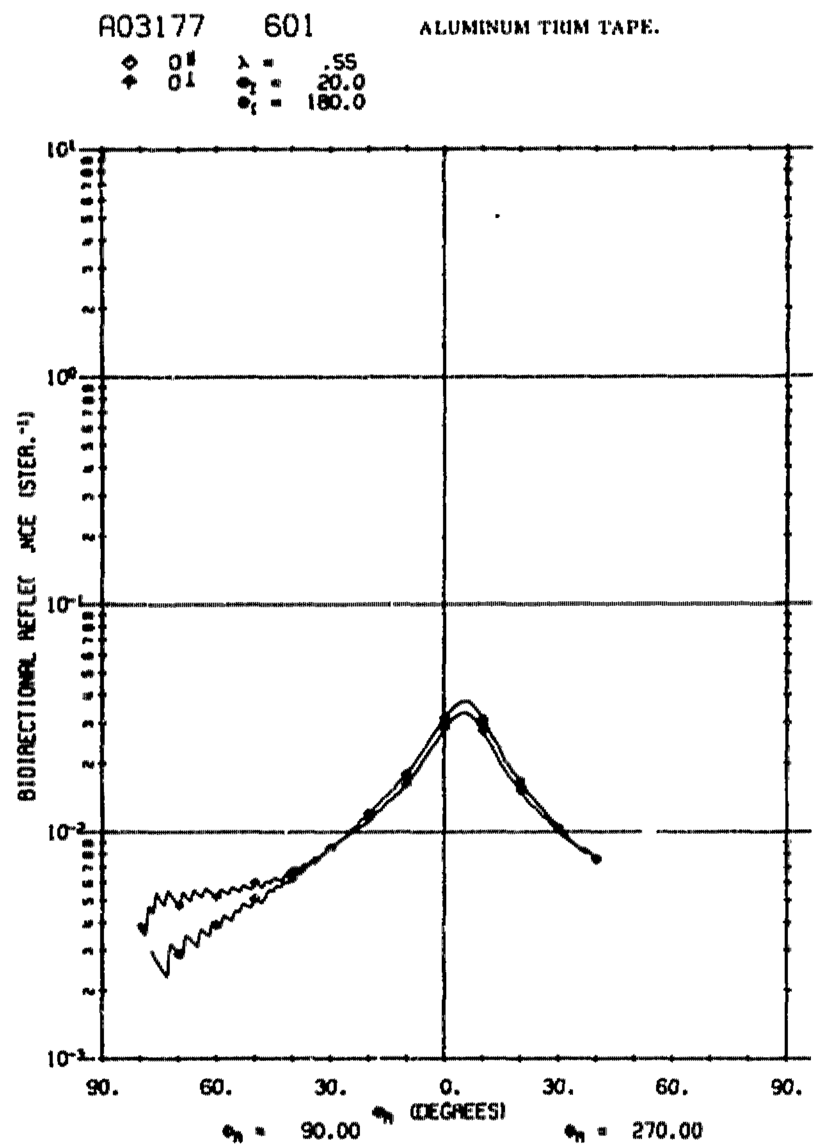
A03177 601
ALUMINUM TRIM TAPE.
λ = .55
θi = .0
φi = 180.0
BIDIRECTIONAL REFLEC..NCE (STER.-1)
θR (DEGREES)
φR = .00
φR = 180.00

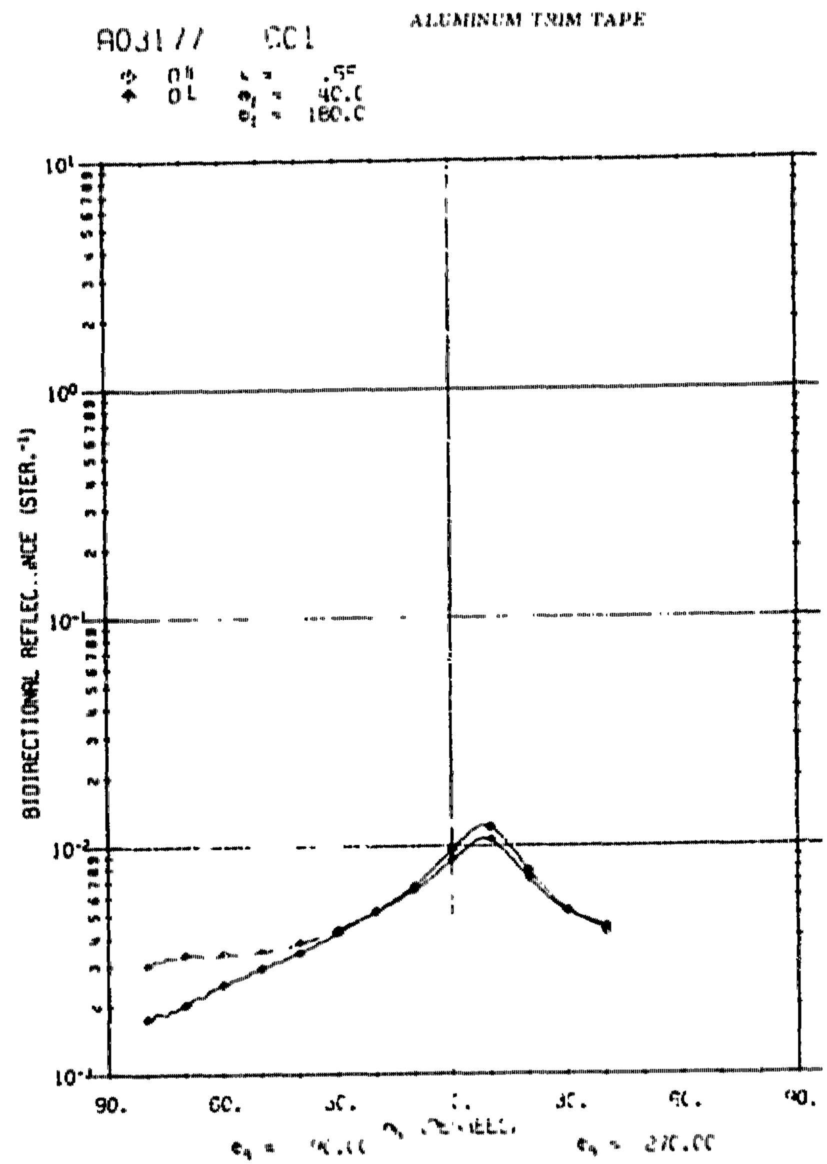


ALUMINUM TRIM TAPE.
φi = 180.0
BIDIRECTIONAL REFLEC NCE (STER.-1)

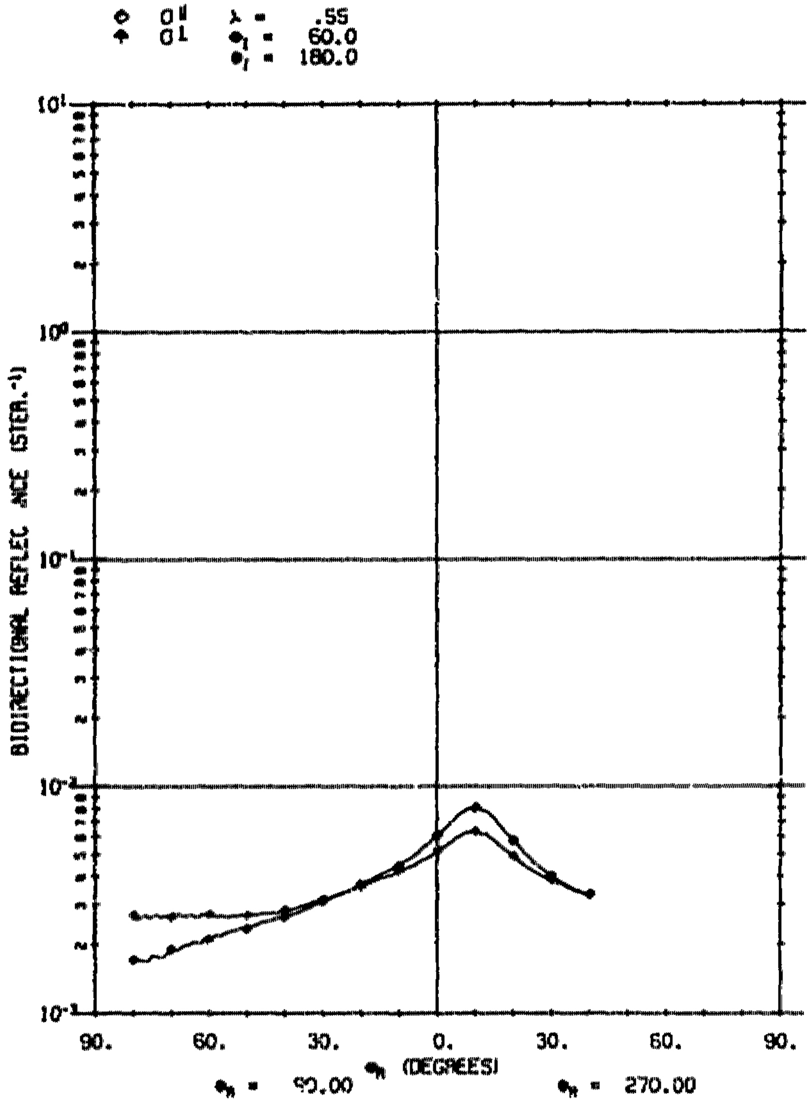

A03177 601
ALUMINUM TRIM TAPE.
λ = .55
40.0
180.0
BIDIRECTIONAL REFLEC..NCE (STER.-1)
90. 60. 30. 0. 30. 60. 90.
(DEGREES)
.00
180.00


ALUMINUM TRIM TAPE
180.0
BIDIRECTIONAL REFLEC. NCE (STER.-1)
90.

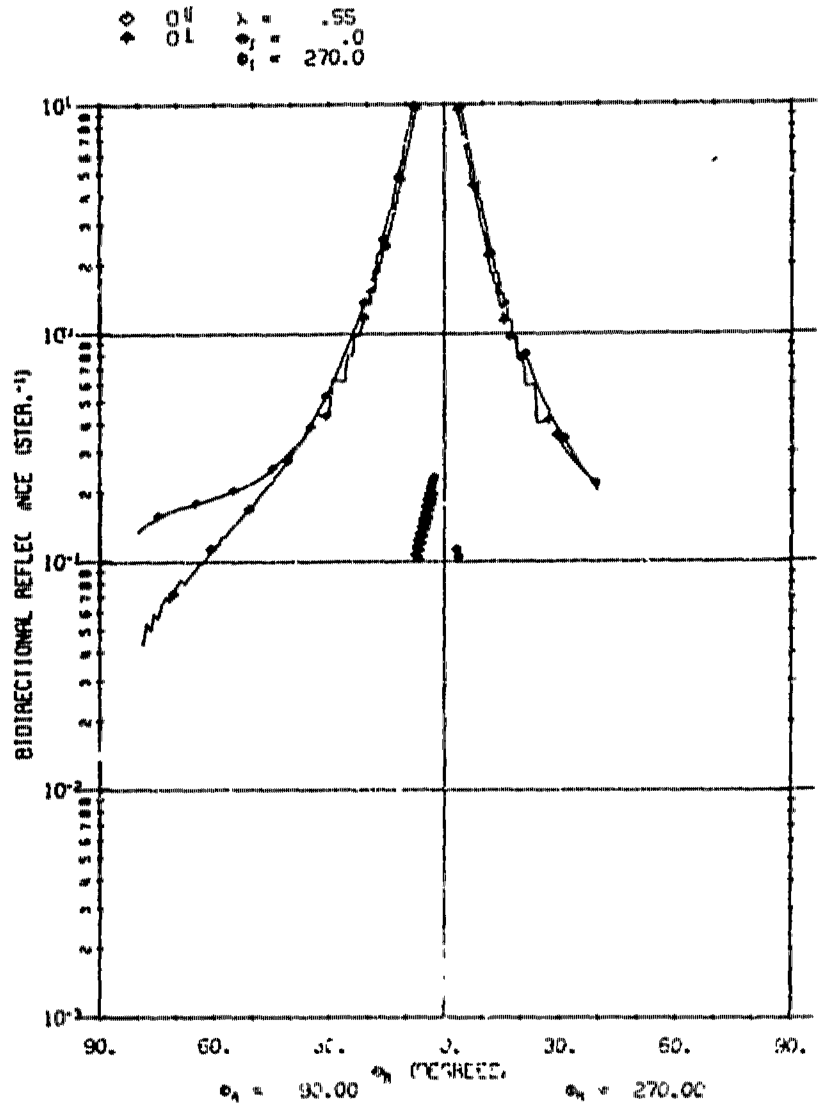

A03177 601
ALUMINUM TRIM TAPE.
O∥
O⊥
λ = .55
20.0
180.0
BIDIRECTIONAL REFLEC .NCE (STER.⁻¹)
90.
60.
30.
0.
30.
60.
90.
(DEGREES)
90.00
270.00

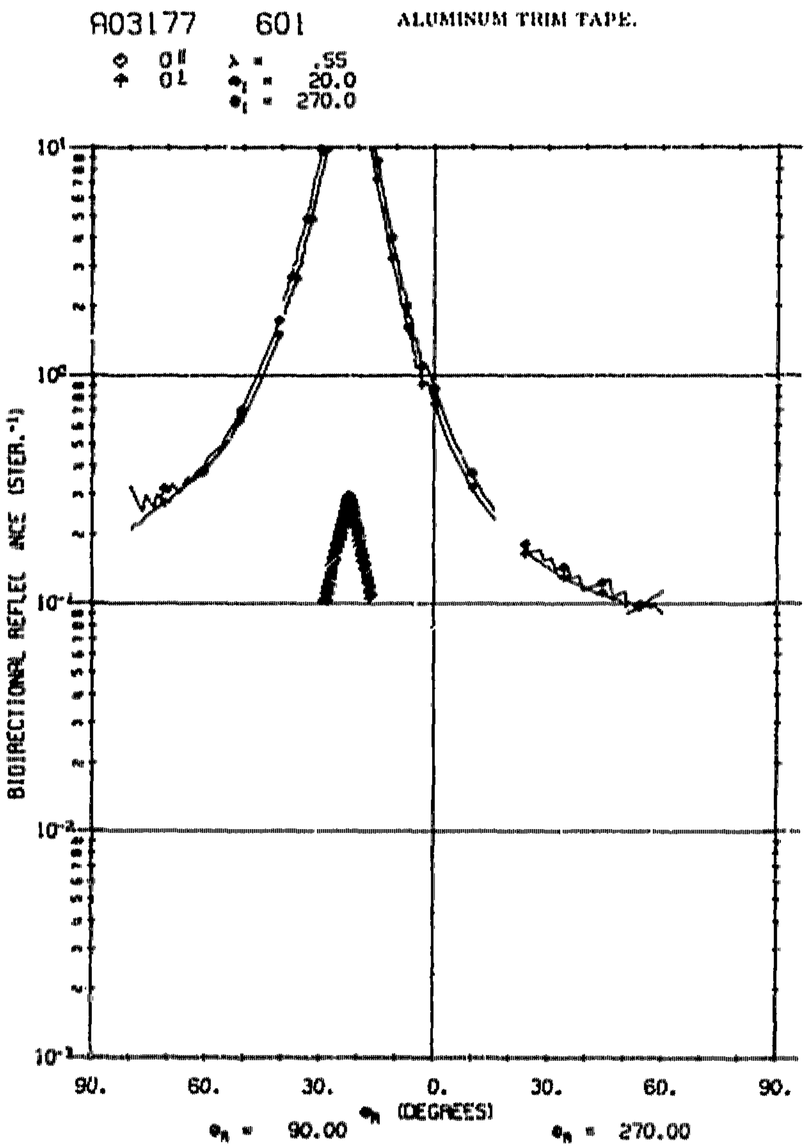

ALUMINUM TRIM TAPE
BIDIRECTIONAL REFLEC..NCE (STER.⁻¹)
90.

A03177 601 ALUMINUM TRIM TAPE.

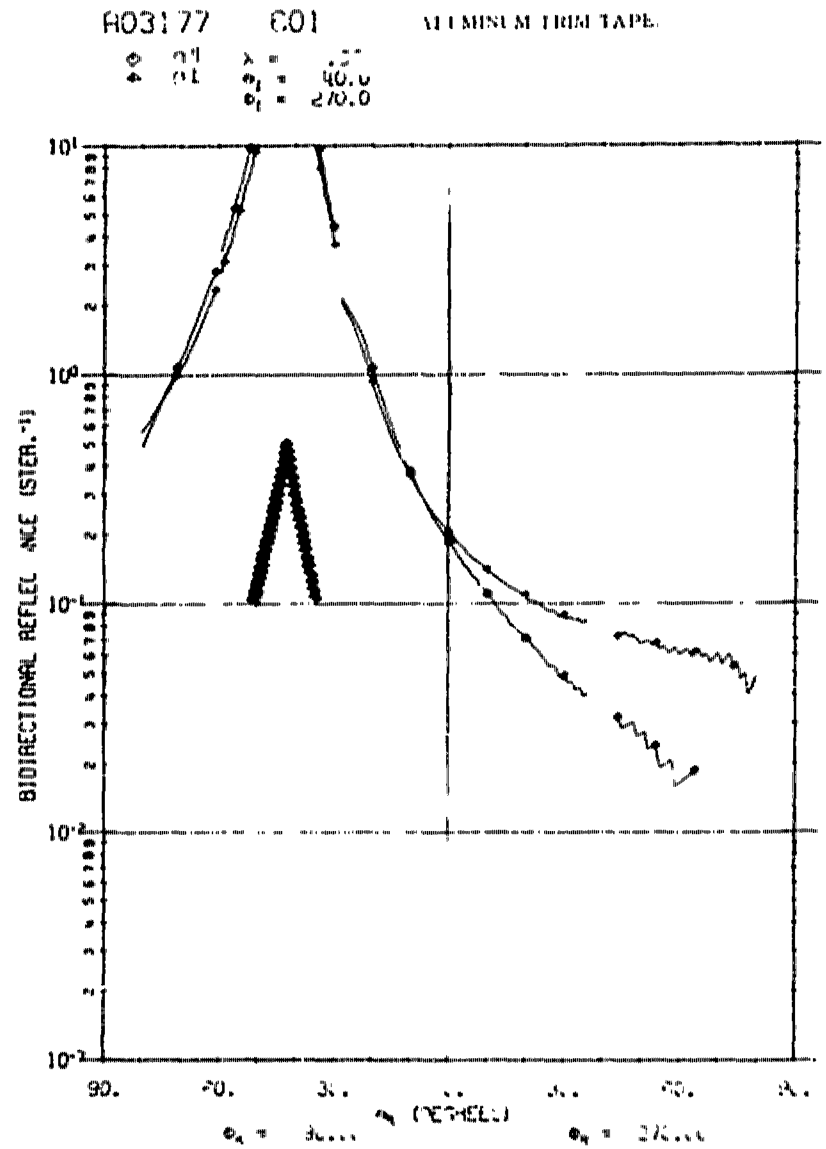


A03177 601 ALUMINUM TRIM TAPE.

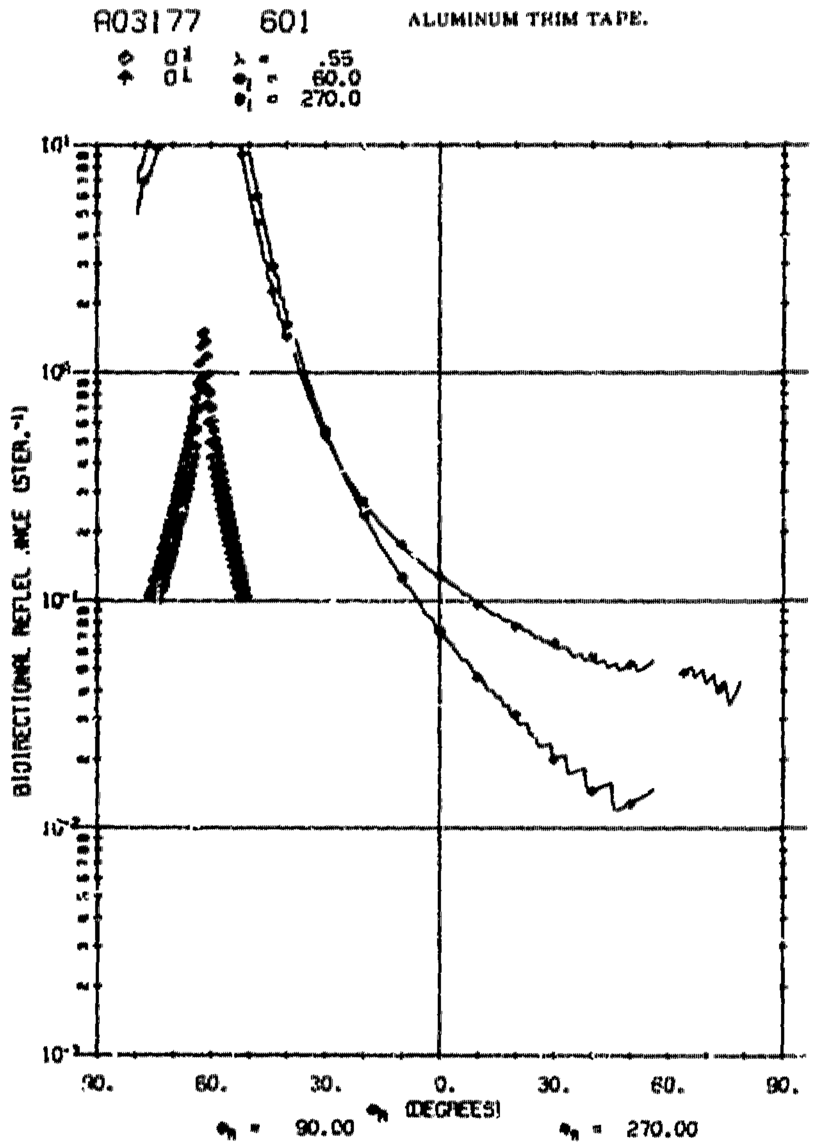




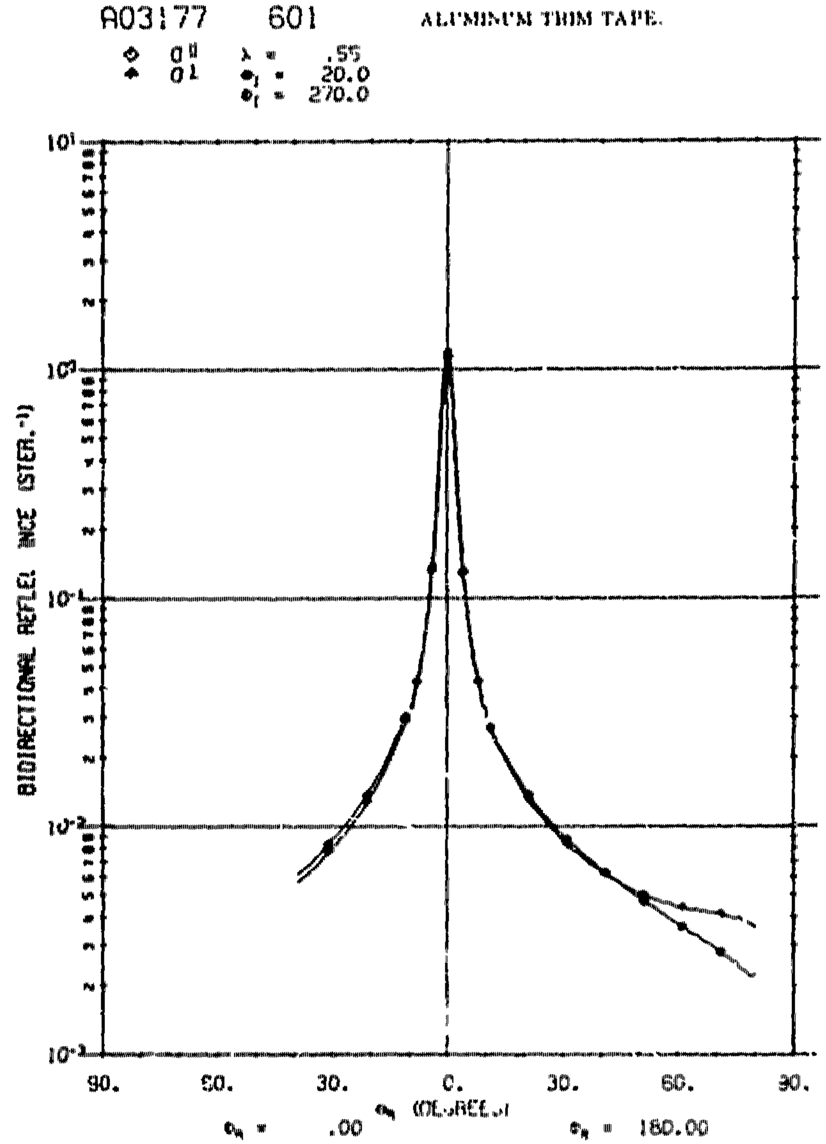
A03177 601
ALUMINUM TRIM TAPE.
0∥
0⊥
λ = .55
θi = 20.0
φi = 270.0
BIDIRECTIONAL REFLEC NCE (STER.-1)
10^1
10^0
10^-1
10^-2
10^-3
90.
60.
30.
0.
30.
60.
90.
θR (DEGREES)
φR = 90.00
φR = 270.00



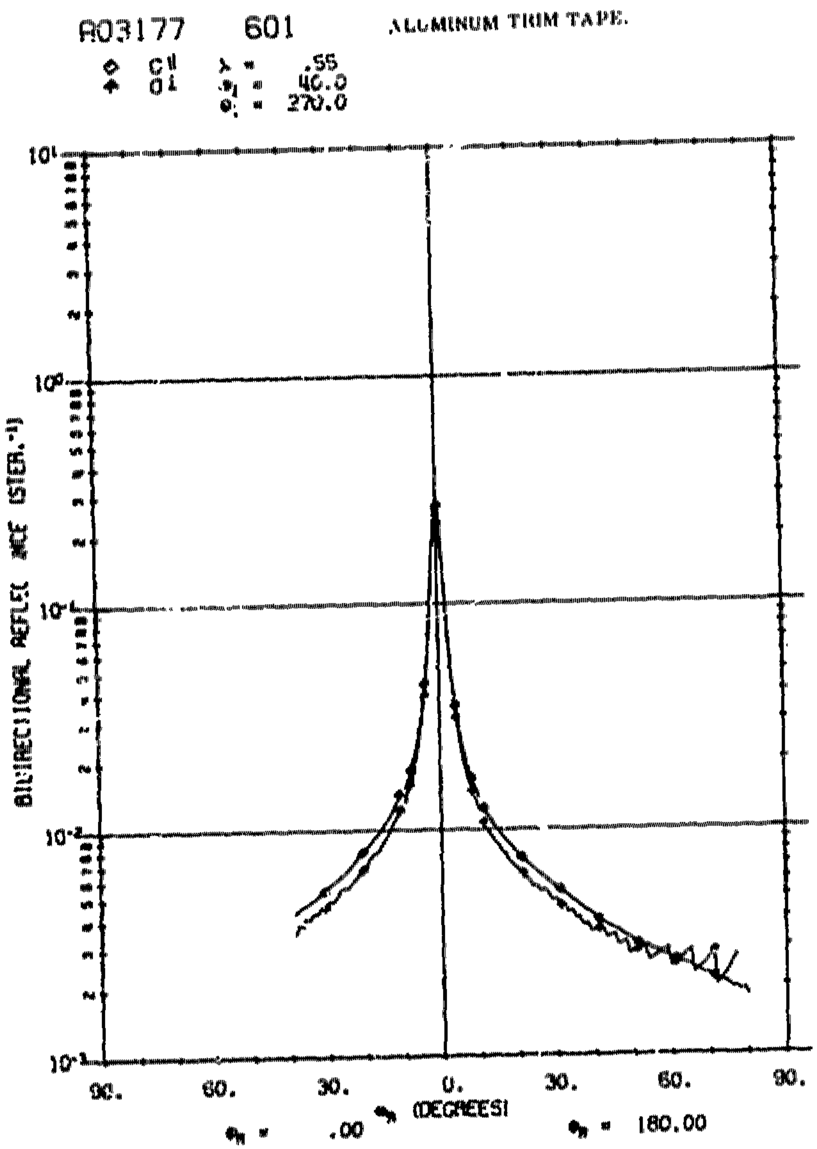
A03177 601
BIDIRECTIONAL REFLEC NCE (STER.-1)
10^1
10^0
10^-1
10^-2
10^-3
90.



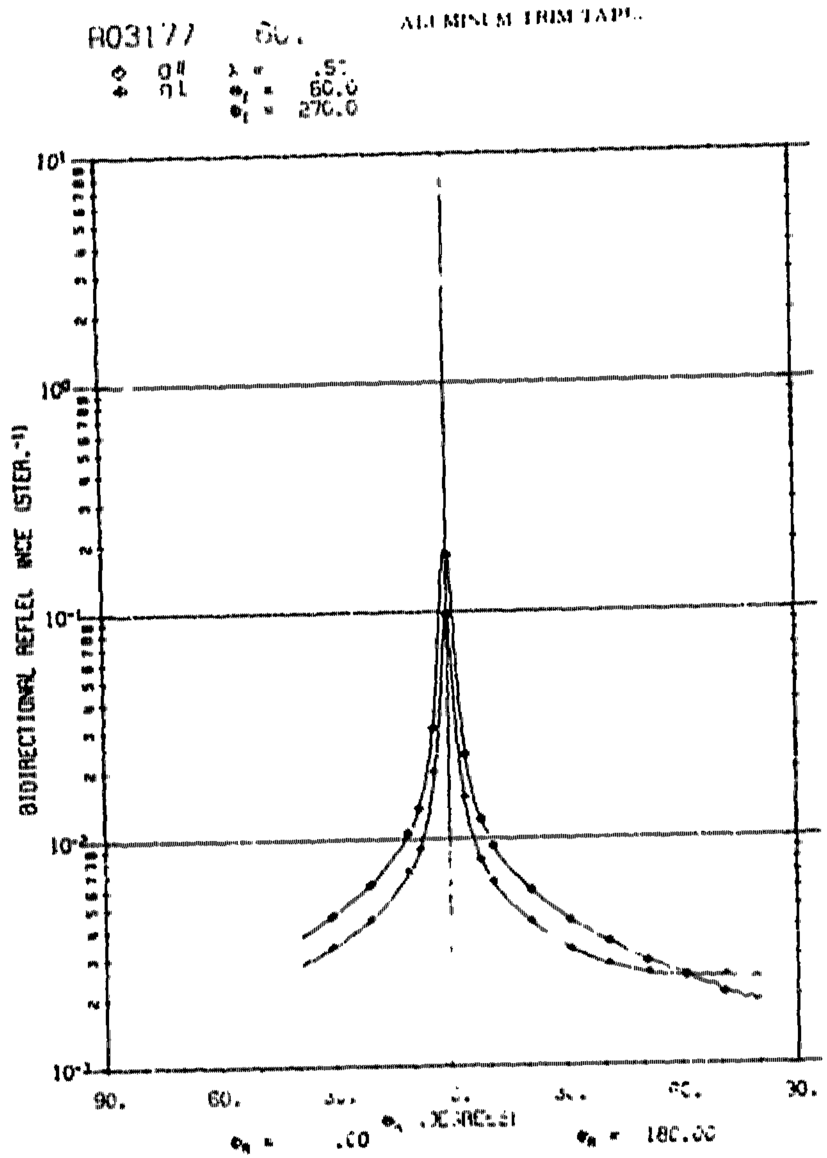
A03177 601 ALUMINUM TRIM TAPE.
◇ ρ∥ λ = .55
✦ ρ⊥ θi = 60.0
φi = 270.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
φR = 90.00
φR = 270.00



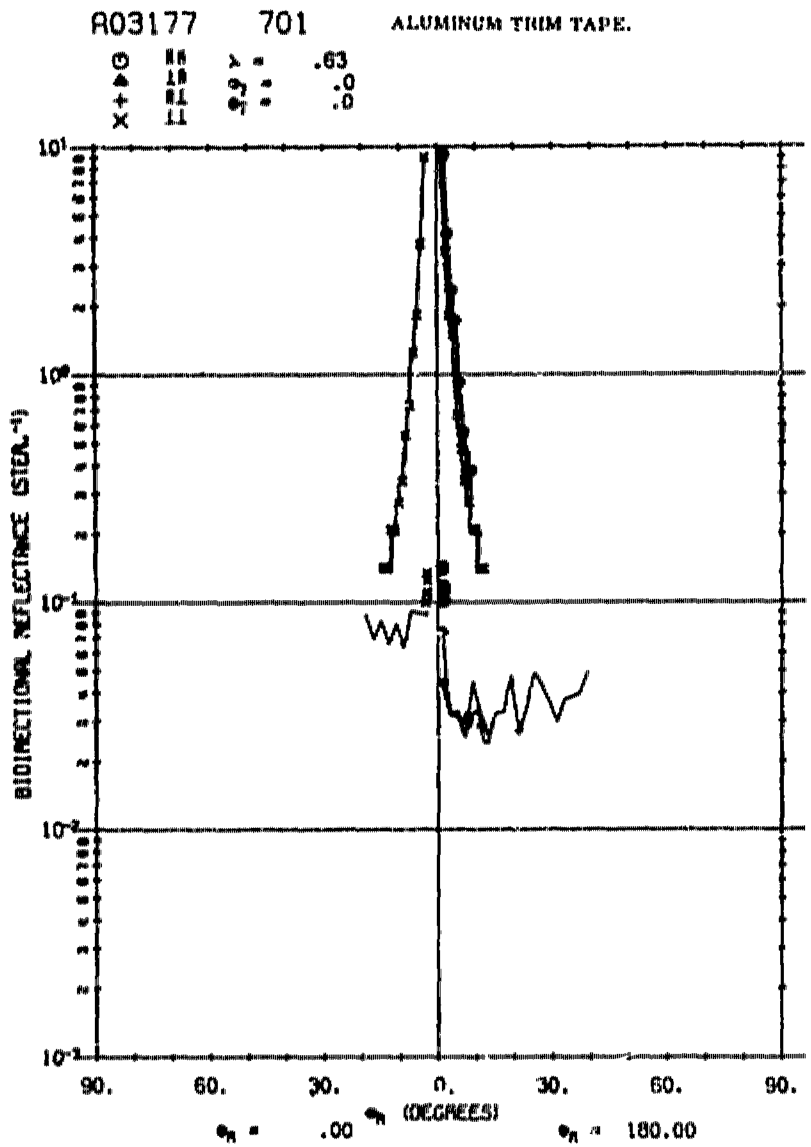
A03177 601 ALUMINUM TRIM TAPE.
◇ ρ∥ λ = .55
✦ ρ⊥ θi = 20.0
φi = 270.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
φR = .00
φR = 180.00

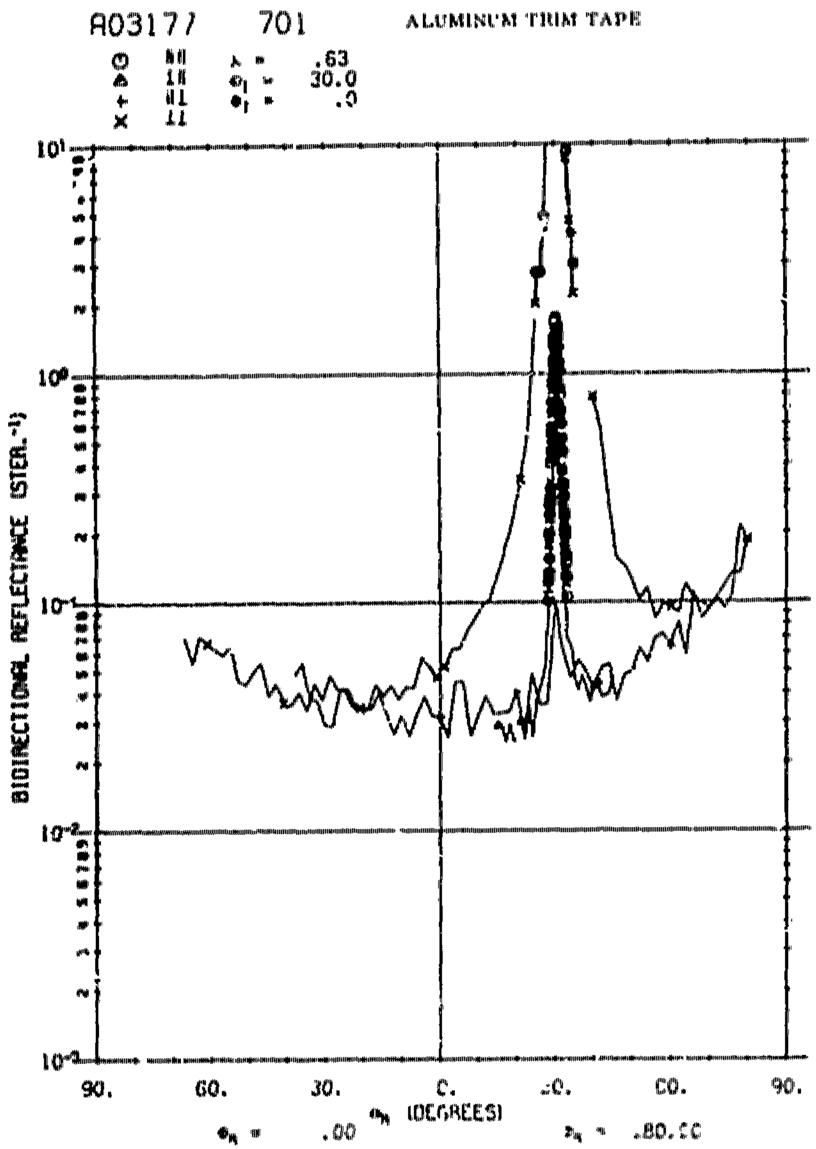


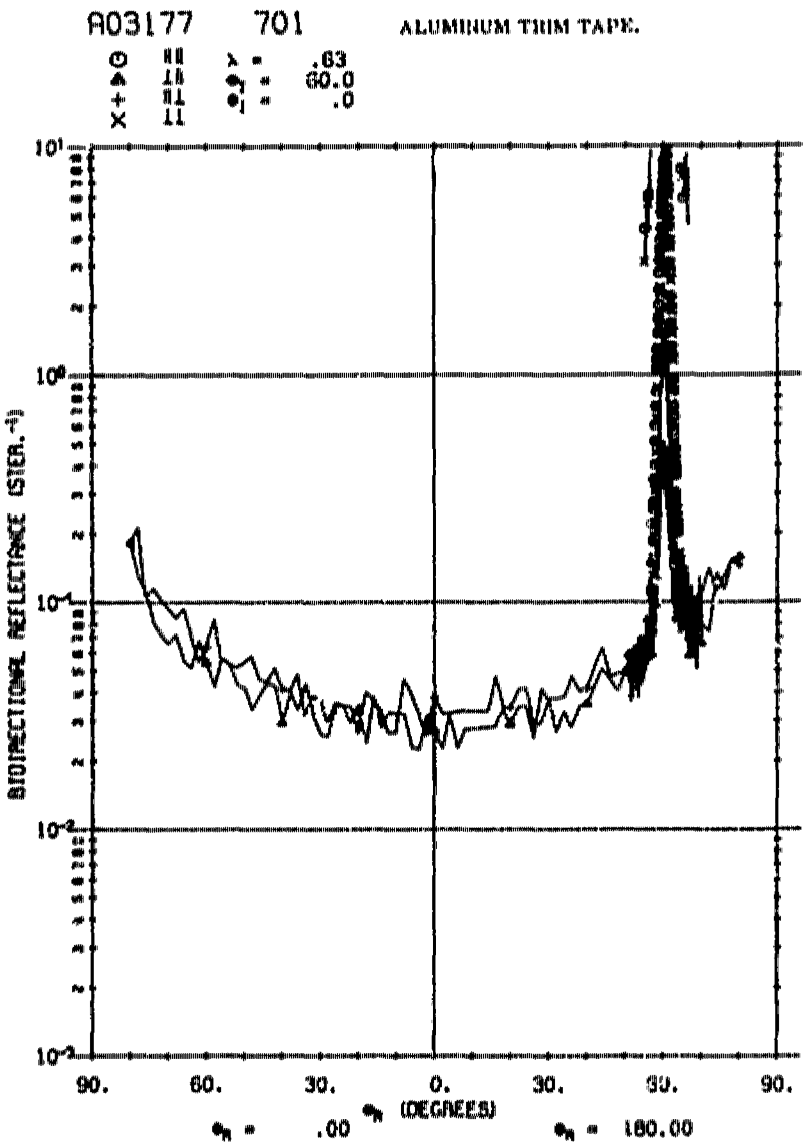
A03177 601
ALUMINUM TRIM TAPE.
λ = .55
40.0
270.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
(DEGREES)
180.00

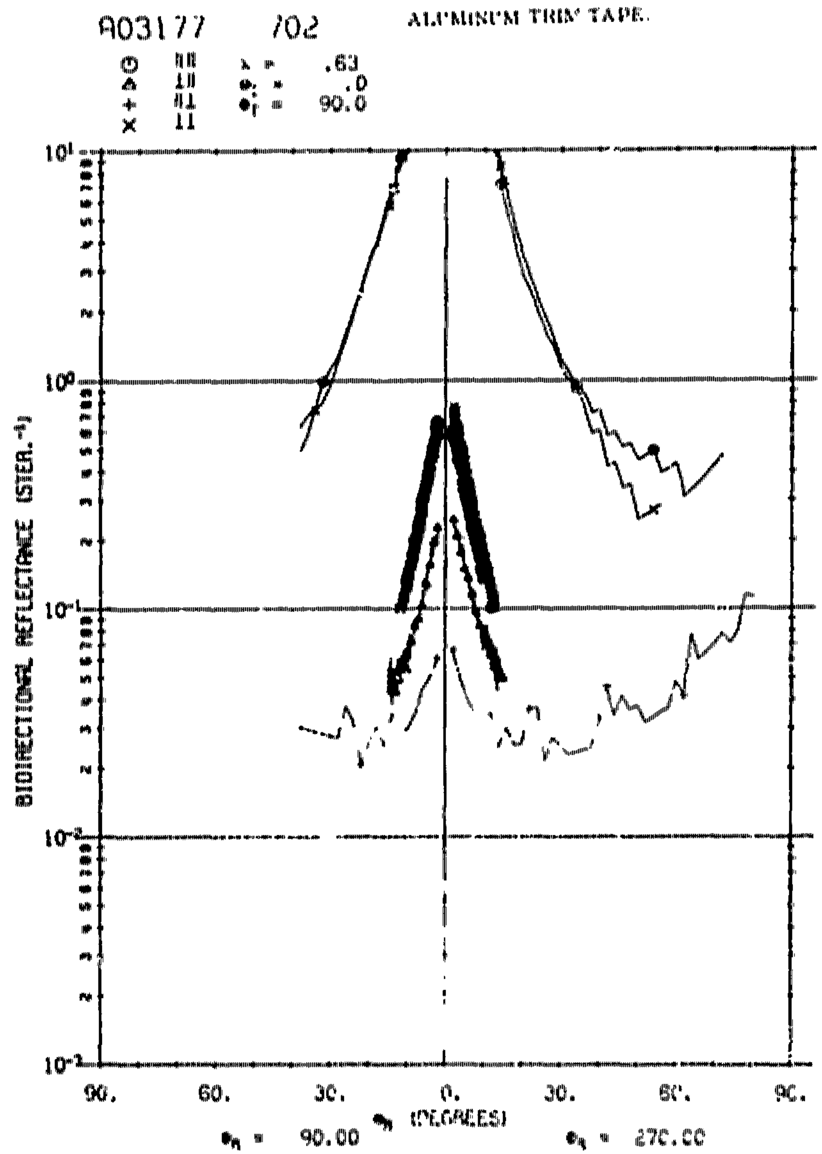


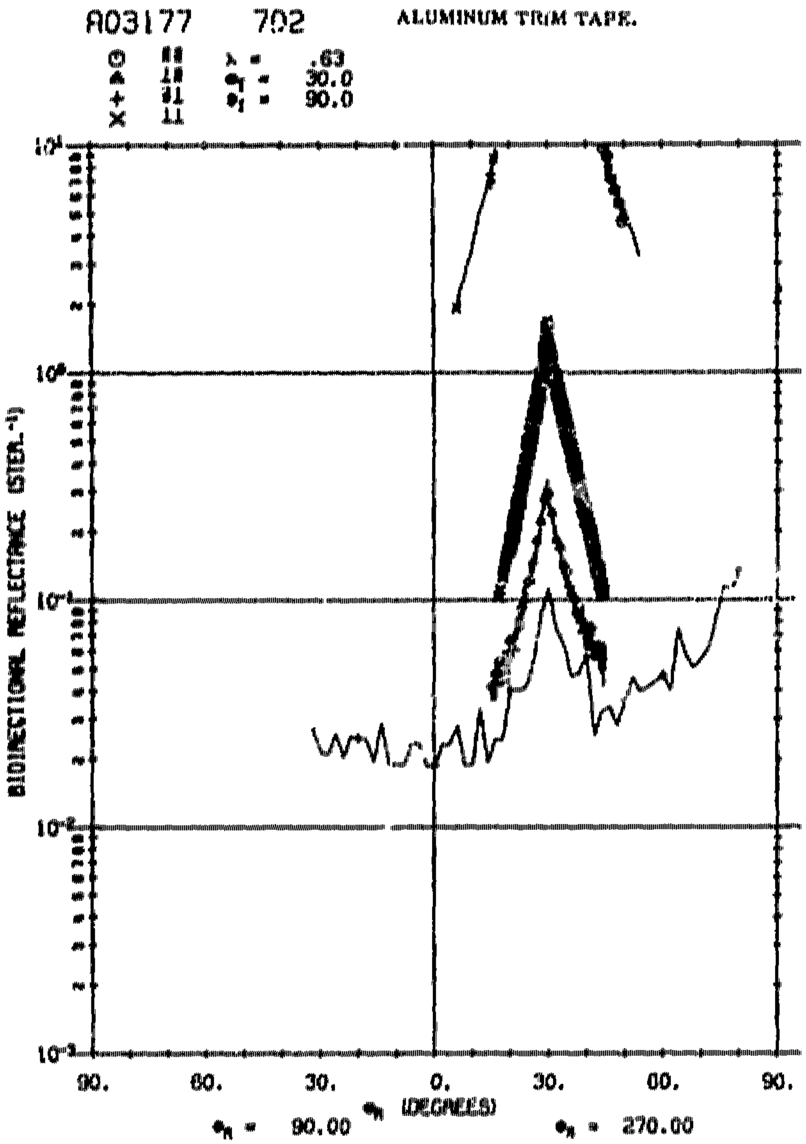
A03177
ALUMINUM TRIM TAPE.
60.0
270.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30.
180.00

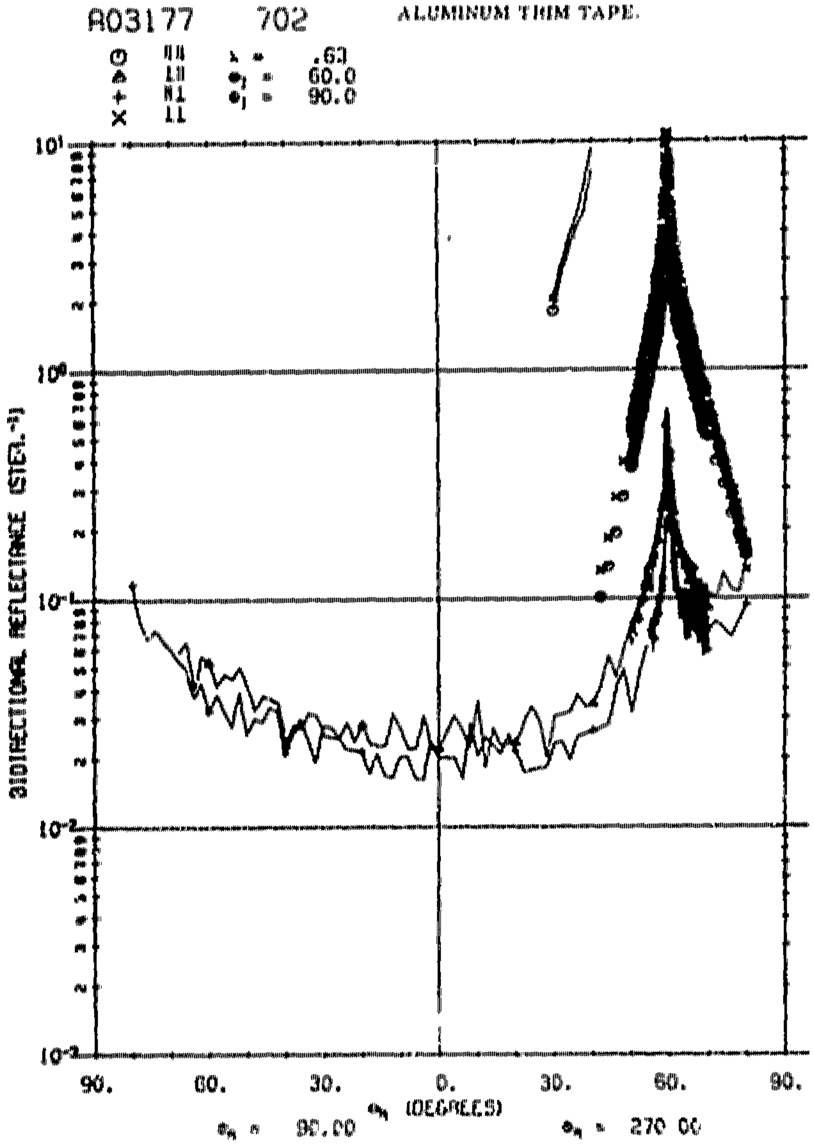

A03177 701 ALUMINUM TRIM TAPE.
λ = .63
.0
.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
.00
180.00

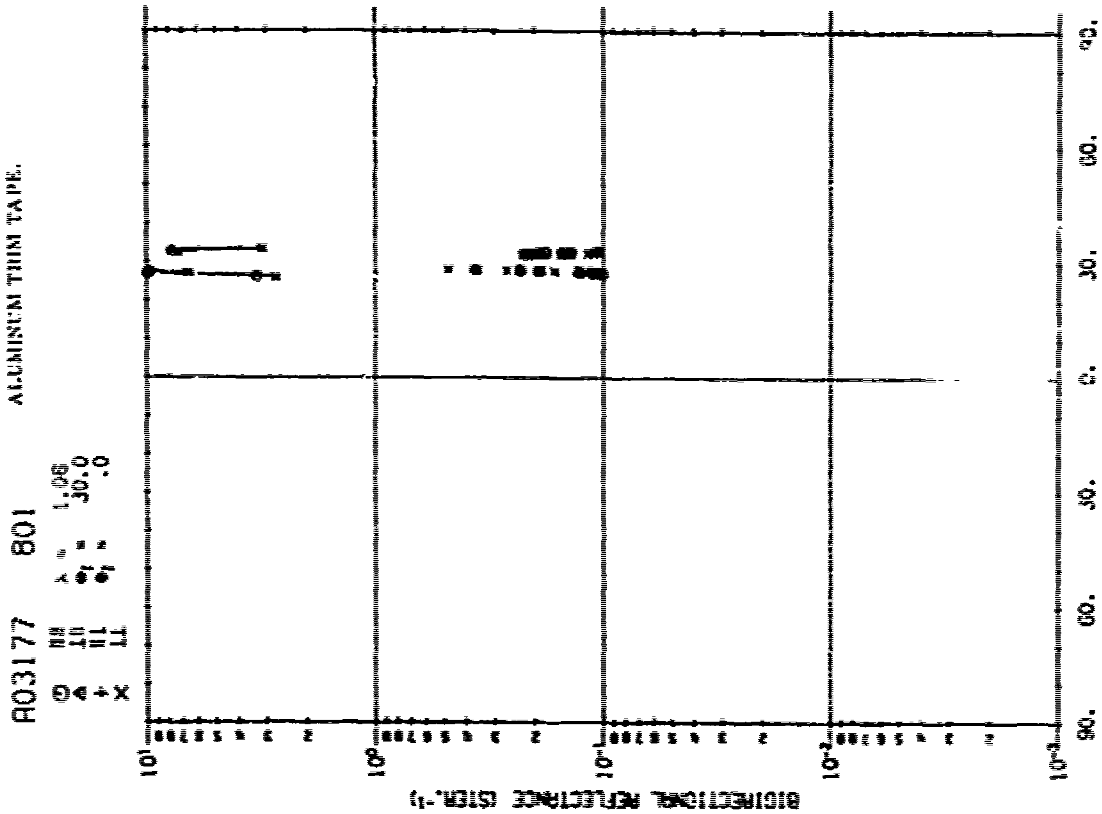

A03177 701 ALUMINUM TRIM TAPE
λ = .63
30.0
.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
.00

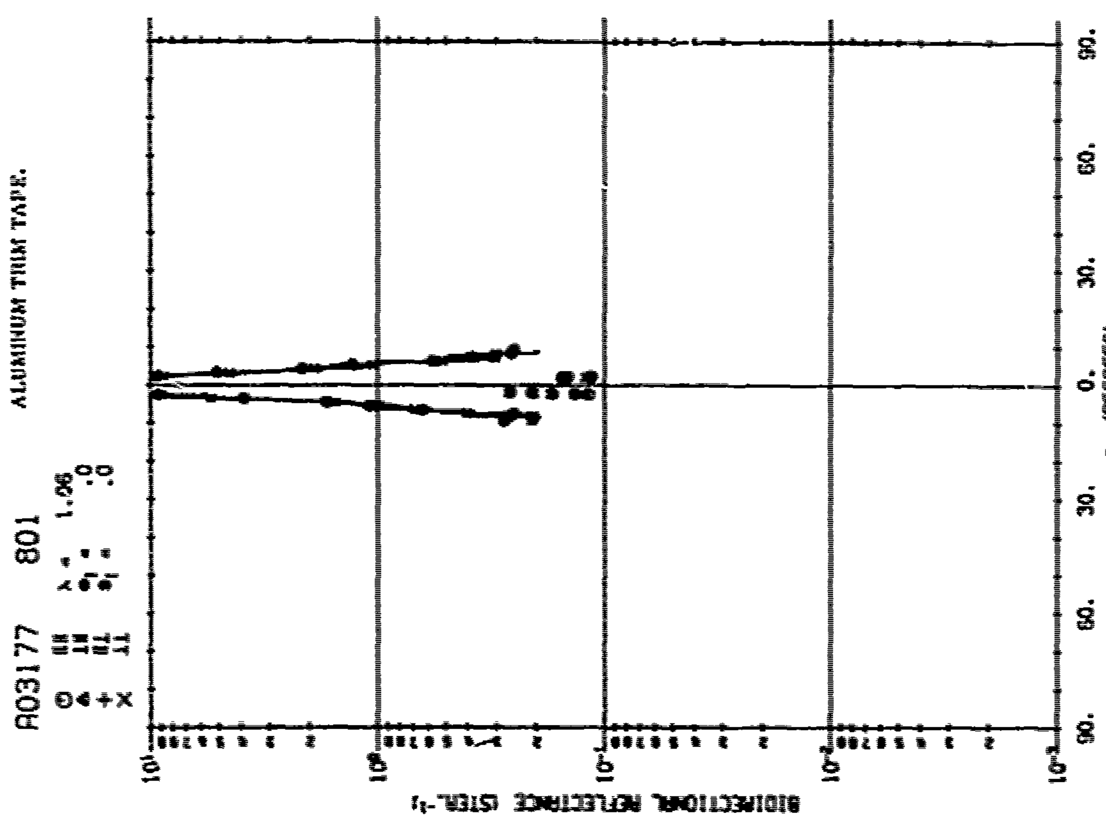

A03177 701
ALUMINUM TRIM TAPE.
λ = .63
θ_i = 60.0
ϕ_i = .0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00

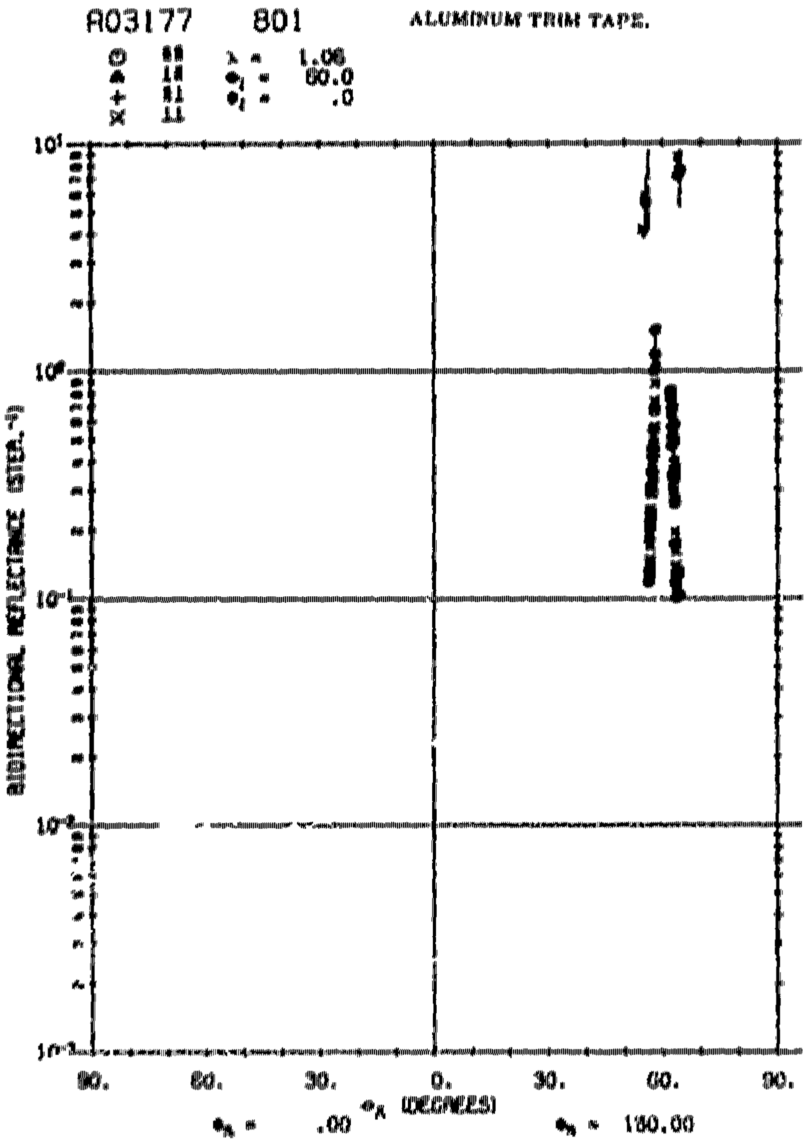

A03177 702
ALUMINUM TRIM TAPE.
λ = .63
θ_i = .0
ϕ_i = 90.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00

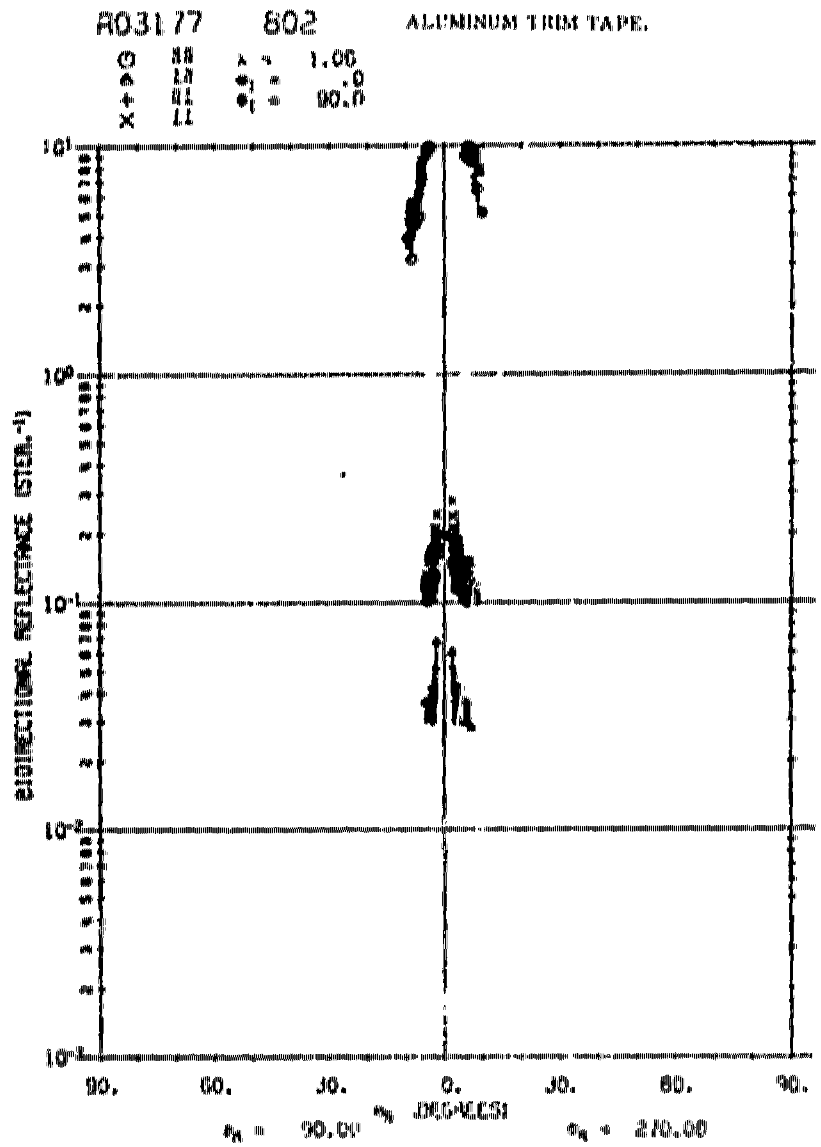

A03177 702 ALUMINUM TRIM TAPE.
⊙ ∥ λ = .63
▲ ⊥∥ θi = 30.0
+ ∥⊥ φi = 90.0
X ⊥⊥
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = 90.00
φR = 270.00

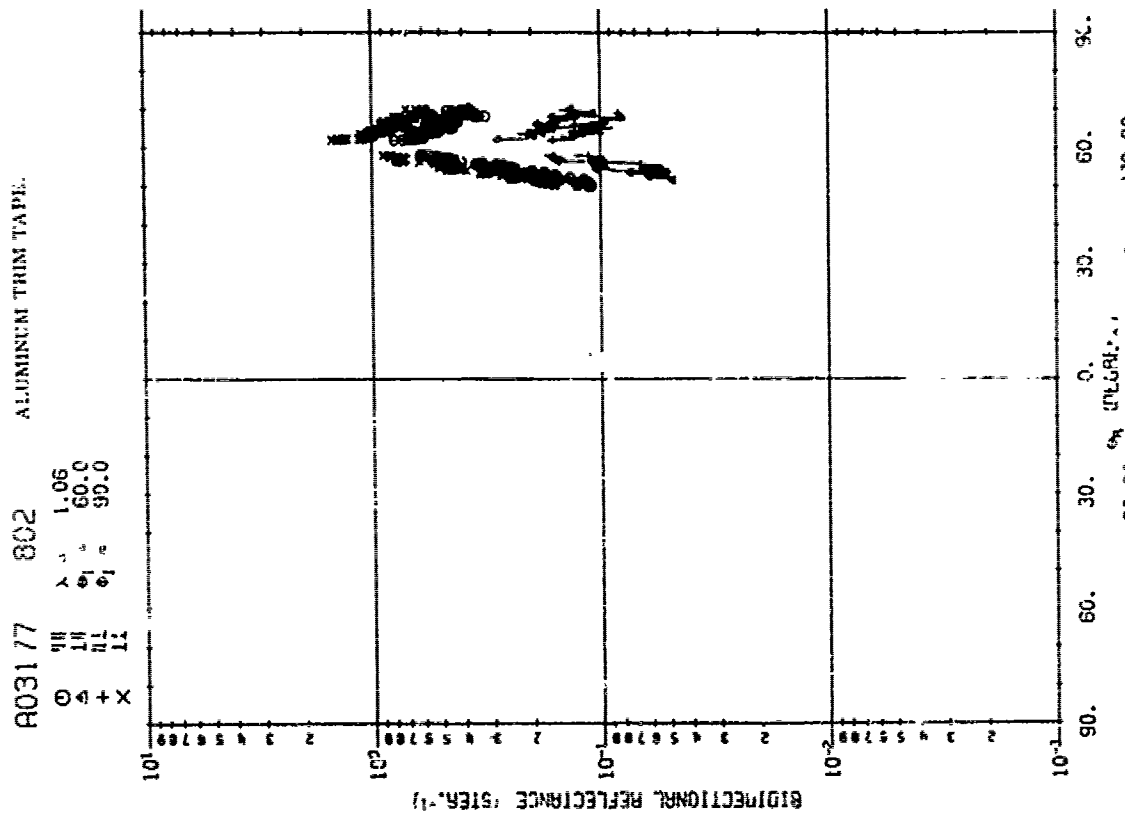

A03177 702 ALUMINUM TRIM TAPE.
⊙ ∥ λ = .63
▲ ⊥∥ θi = 60.0
+ ∥⊥ φi = 90.0
X ⊥⊥
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = 90.00
φR = 270.00


A03177 801
ALUMINUM TRIM TAPE.
λ = 1.06
θi = 30.0
φi = .0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θs (DEGREES)
φs = .00
φs = 180.00

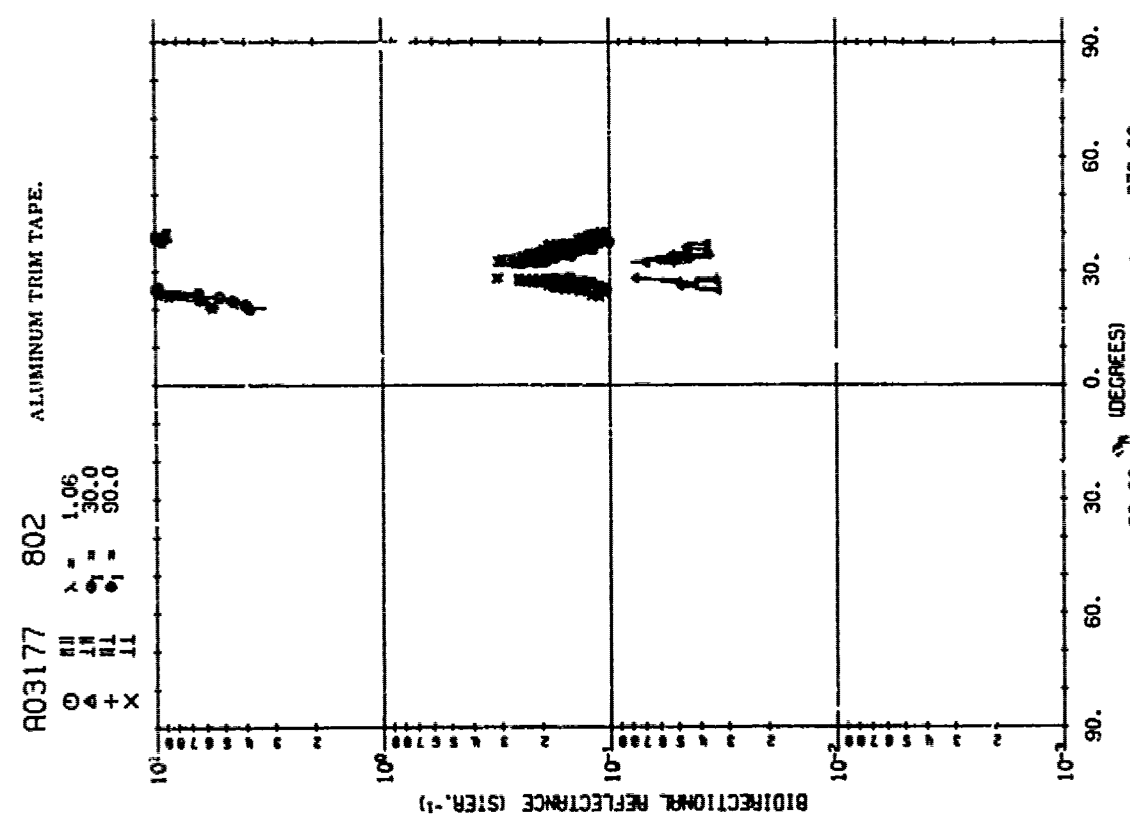

A03177 801
ALUMINUM TRIM TAPE.
λ = 1.06
θi = .0
φi = .0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θs (DEGREES)
φs = .00
φs = 180.00


R03177 801 ALUMINUM TRIM TAPE.
λ = 1.06
θ_i = 60.0
φ_i = .0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
φ_R = .00
φ_R = 180.00

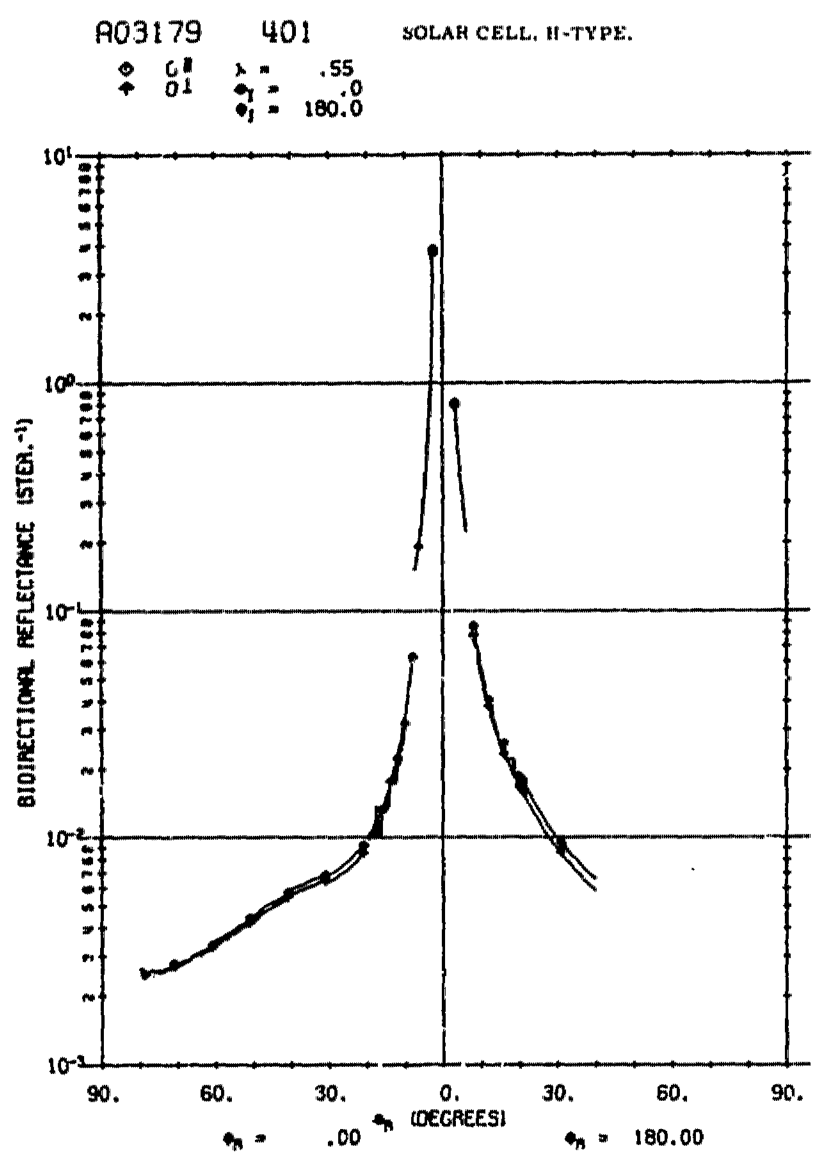

R03177 802 ALUMINUM TRIM TAPE.
λ = 1.06
θ_i = .0
φ_i = 90.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
φ_R = 90.00
φ_R = 270.00

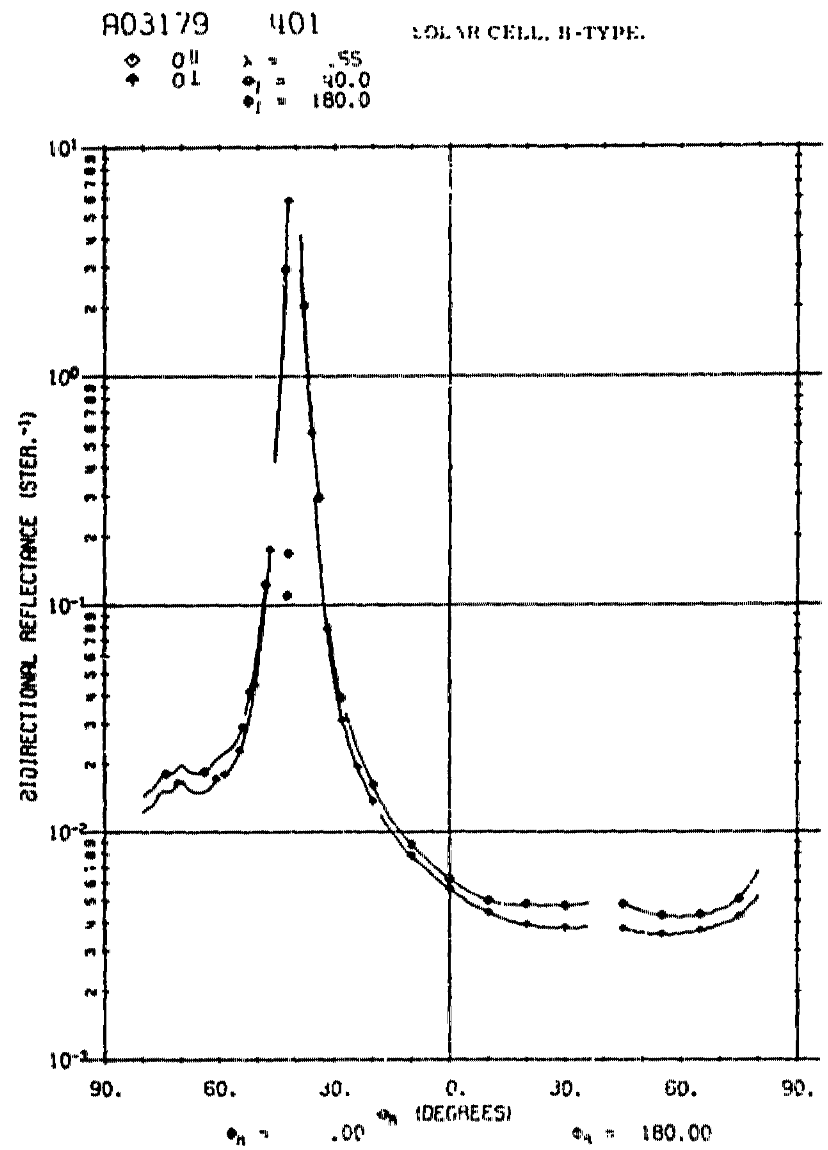


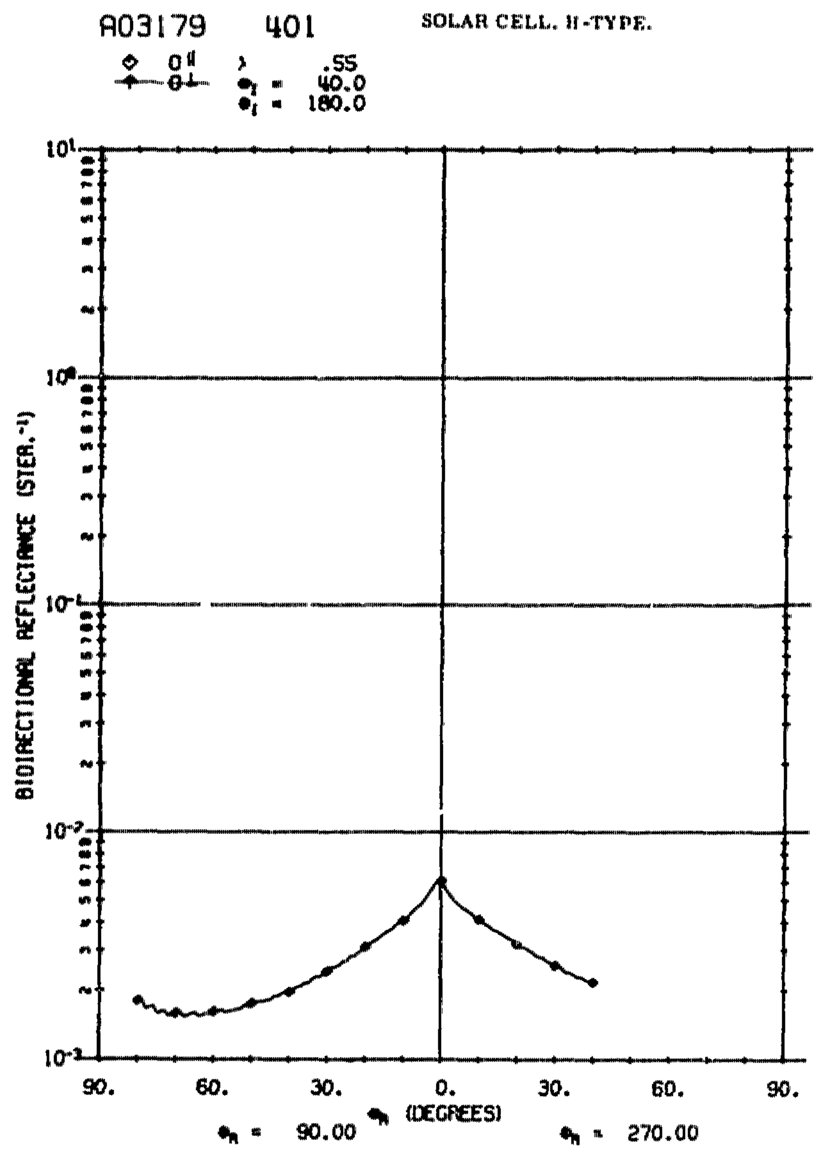
A031 77 802
λ = 1.06
θ = 60.0
φ = 90.0
ALUMINUM TRIM TAPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
φ = 90.00
φ = 270.00

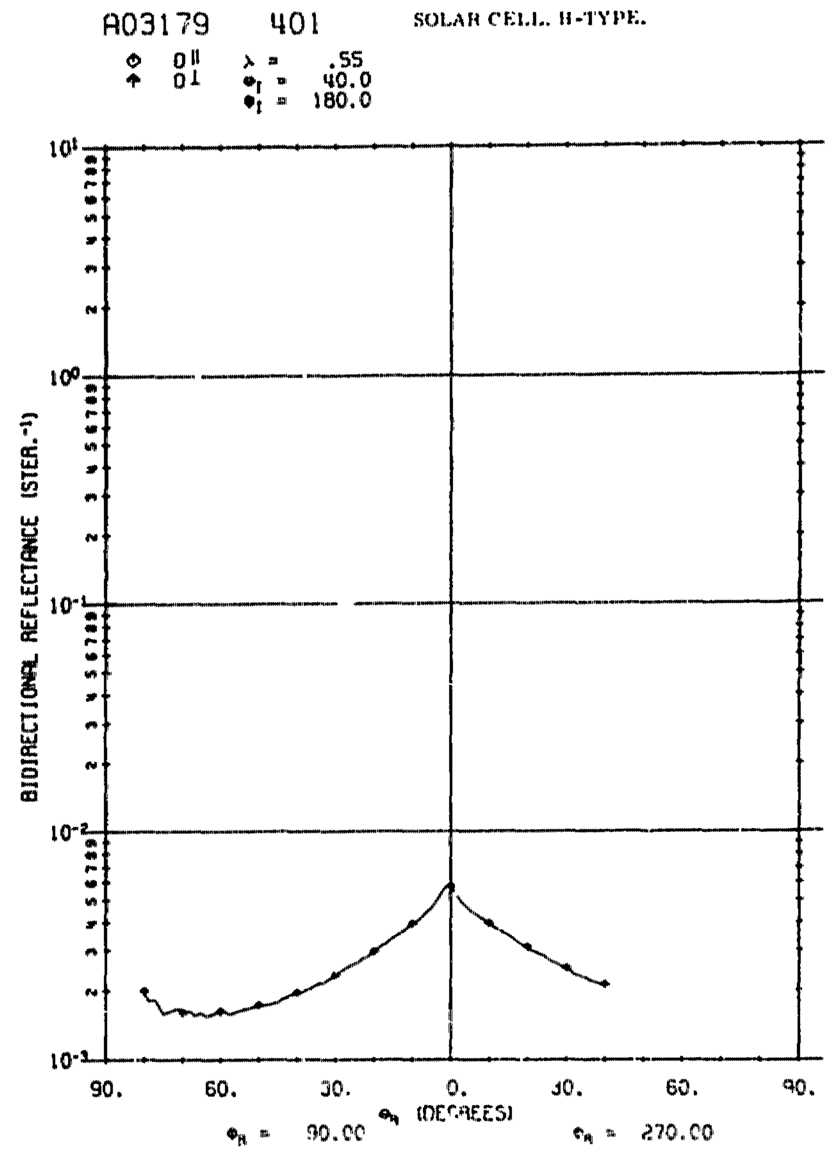


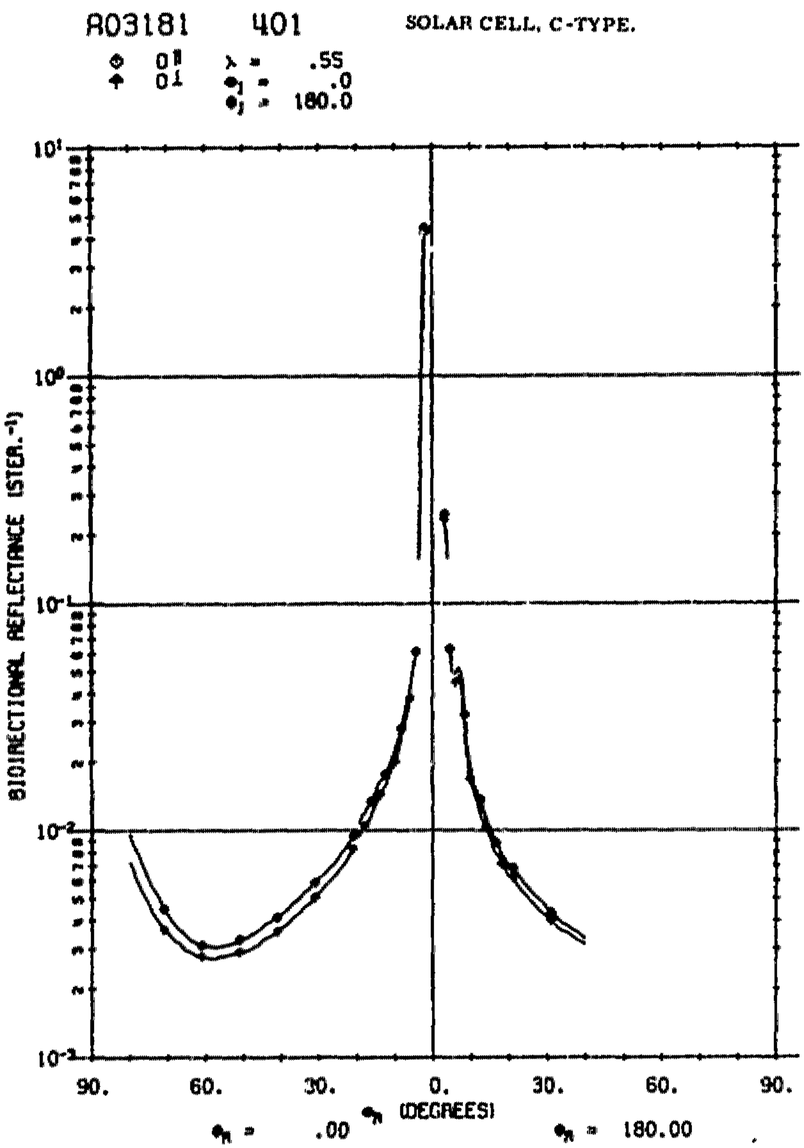
A03177 802
λ = 1.06
θ = 30.0
φ = 90.0
ALUMINUM TRIM TAPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
(DEGREES)
φ = 90.00
φ = 270.00

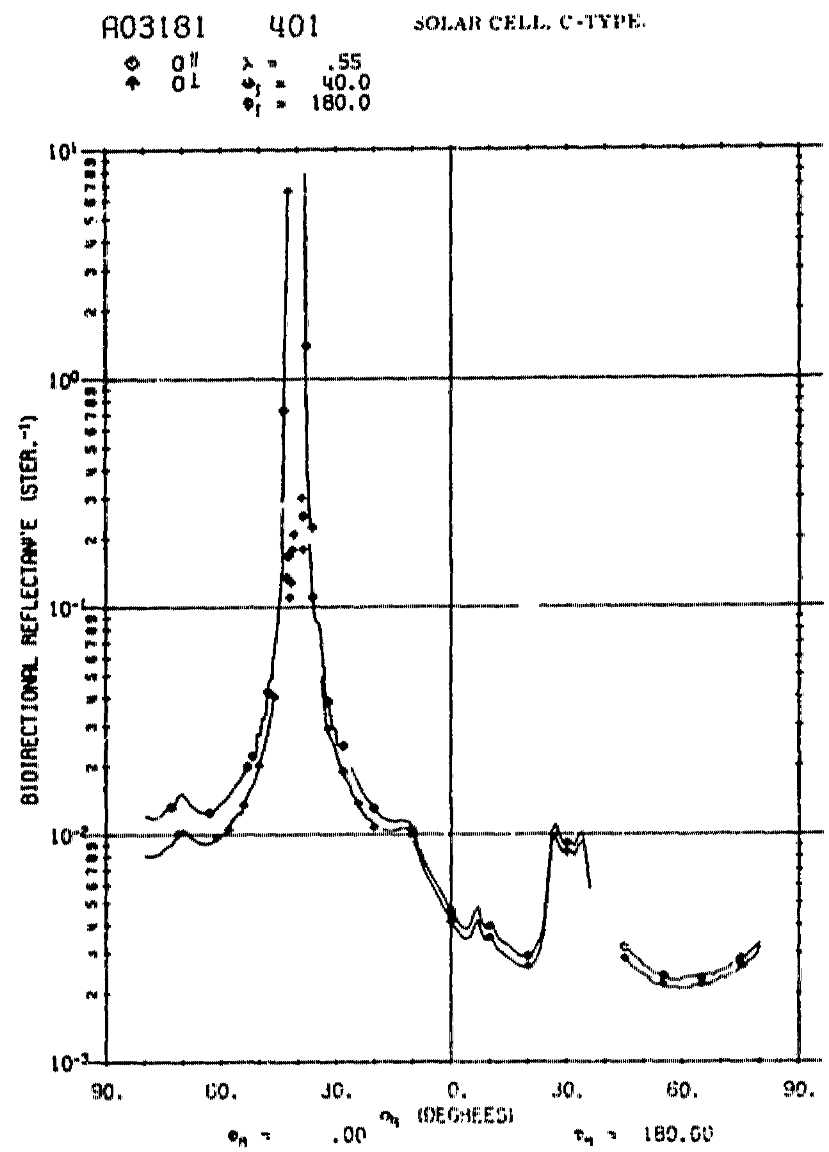

A03179 401 SOLAR CELL, H-TYPE.
◇ C‖ λ = .55
✦ C⊥ ϕ_i = .0
θ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00

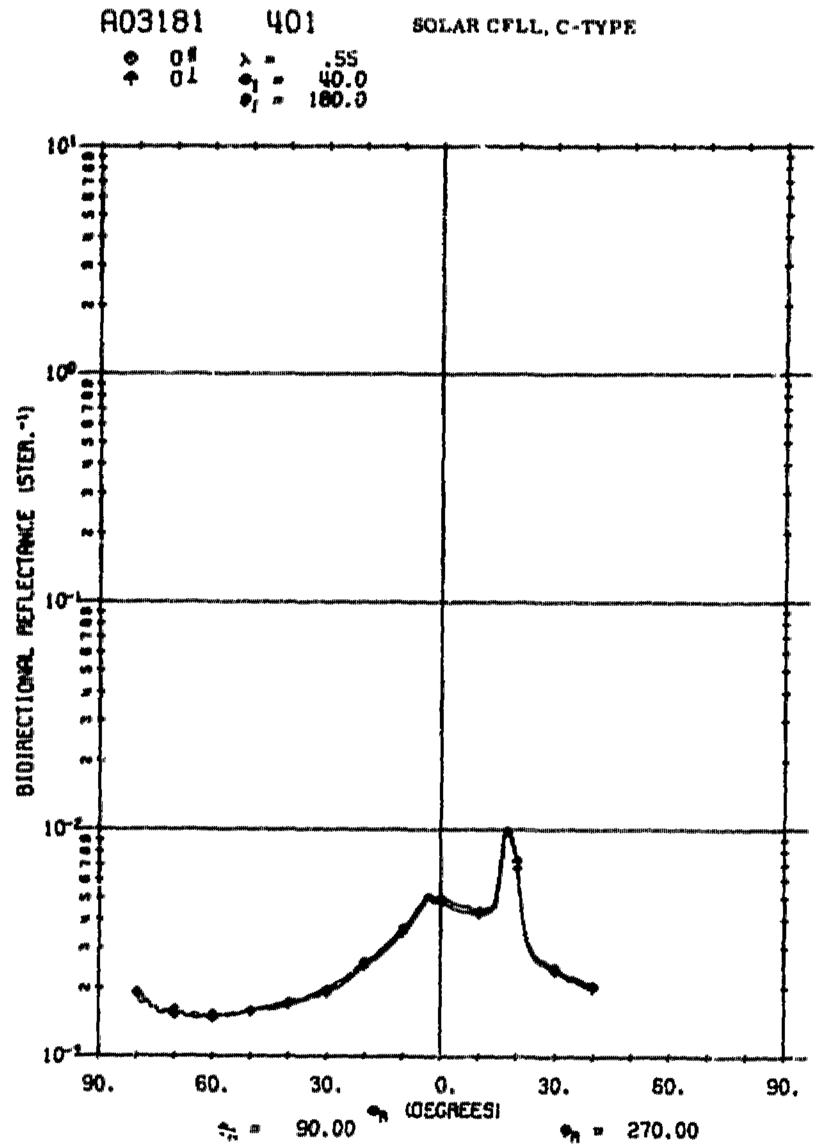

A03179 401 SOLAR CELL, H-TYPE.
◇ C‖ λ = .55
✦ C⊥ ϕ_i = 40.0
θ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00


A03179 401
SOLAR CELL. H-TYPE.
λ = .55
θ_I = 40.0
ϕ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00

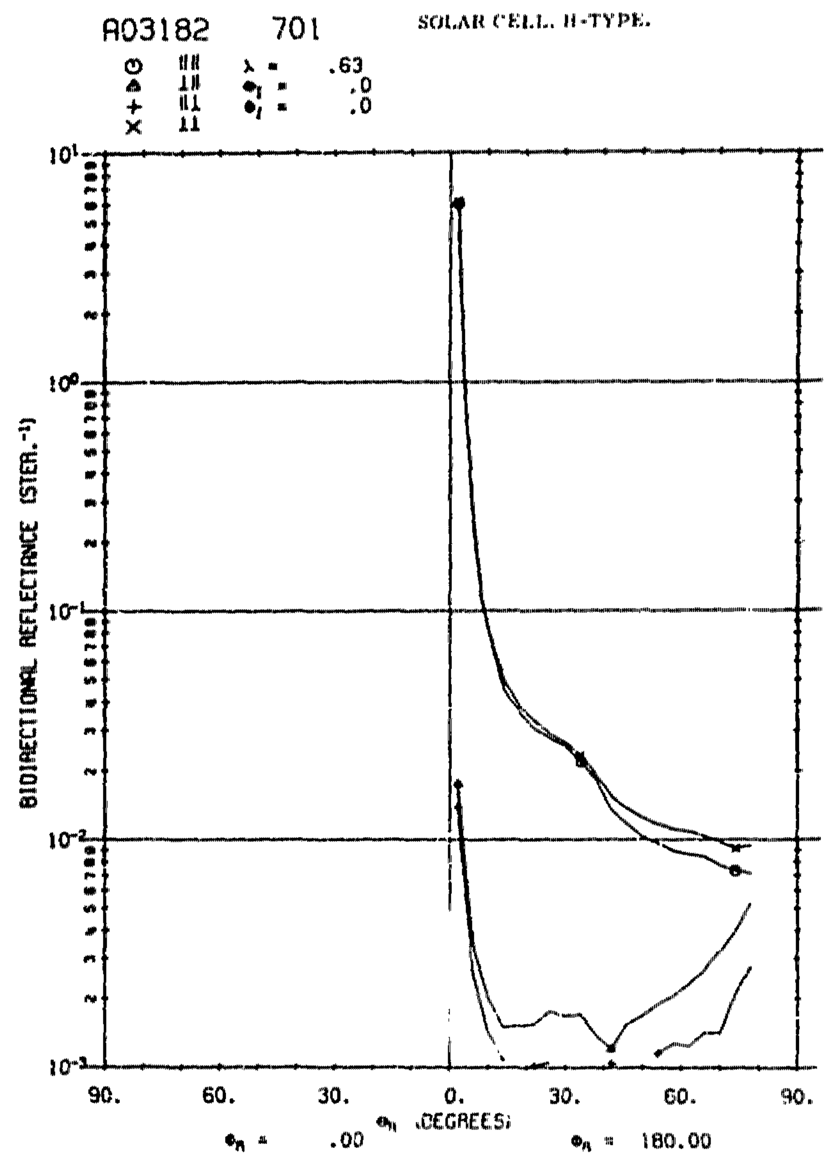

A03179 401
SOLAR CELL. H-TYPE.
λ = .55
θ_I = 40.0
ϕ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00


A03181 401 SOLAR CELL, C-TYPE.
◇ 0∥ λ = .55
✦ 0⊥ θi = .0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
φR = .00
φR = 180.00

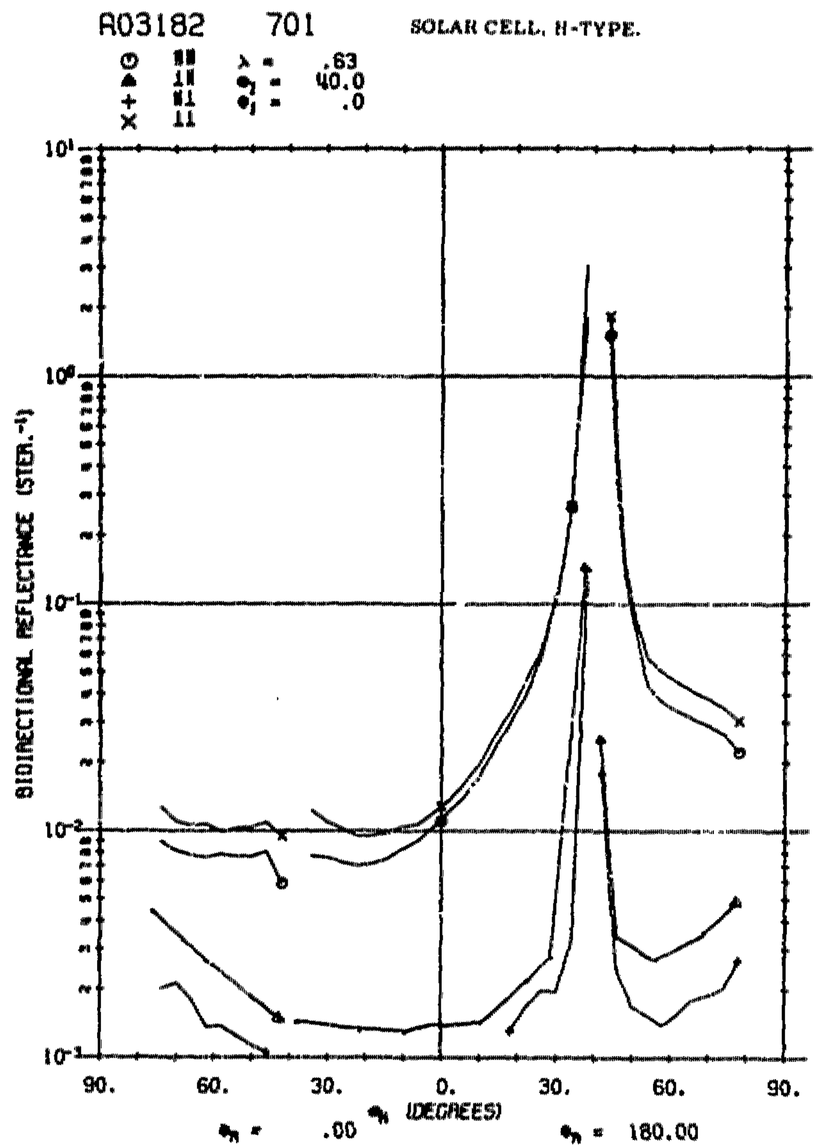

A03181 401 SOLAR CELL, C-TYPE.
◇ 0∥ λ = .55
✦ 0⊥ θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
φR = .00
φR = 180.00

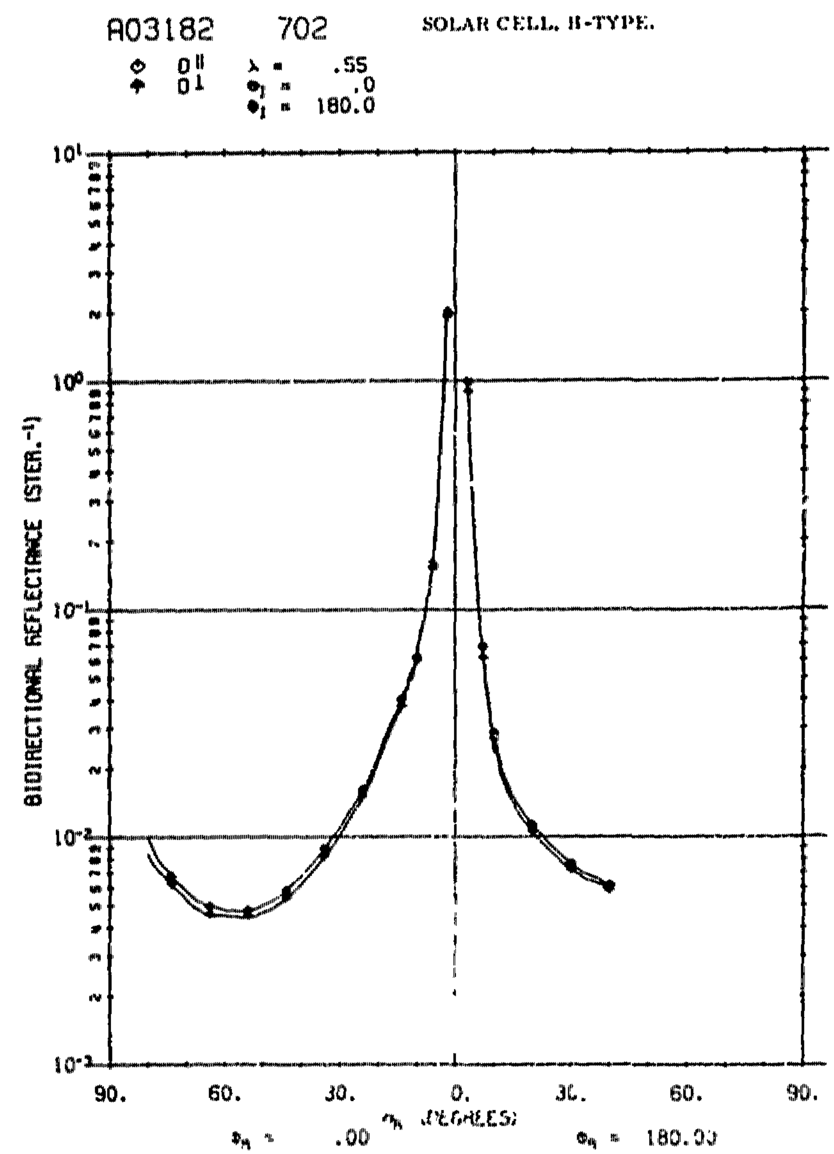


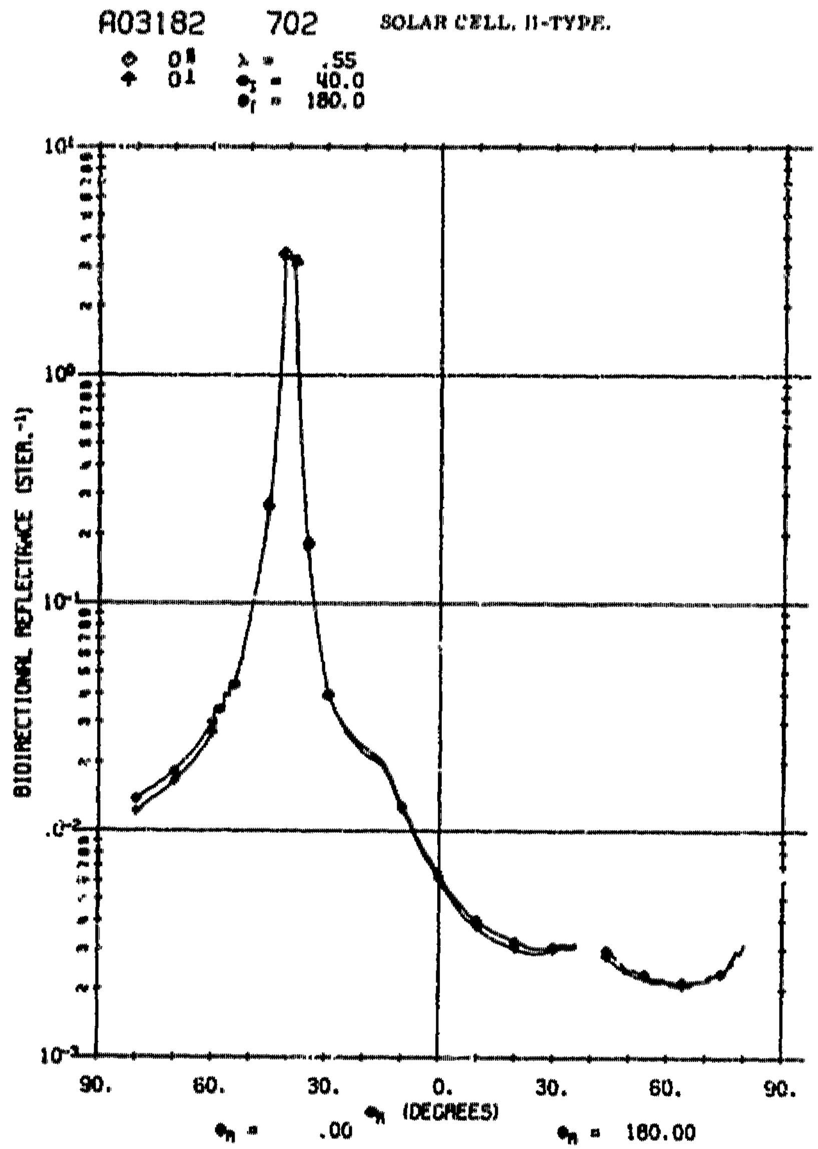
A03181 401
SOLAR CELL, C-TYPE
λ = .55
θ_I = 40.0
ϕ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00



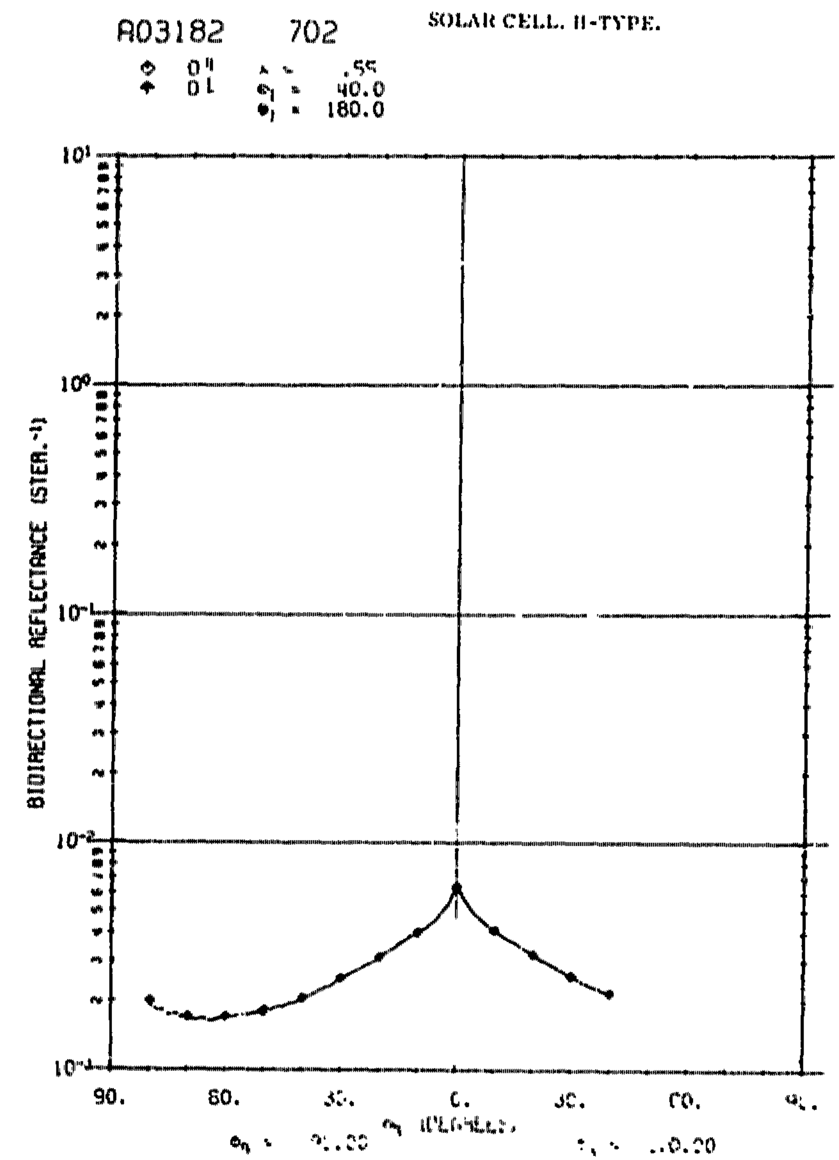
A03182 701
SOLAR CELL, H-TYPE.
λ = .63
θ_I = .0
ϕ_I = .0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00


A03182 701 SOLAR CELL, H-TYPE.
λ = .63
θᵢ = 40.0
φᵢ = .0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θ_R (DEGREES)
φ_R = .00
φ_R = 180.00

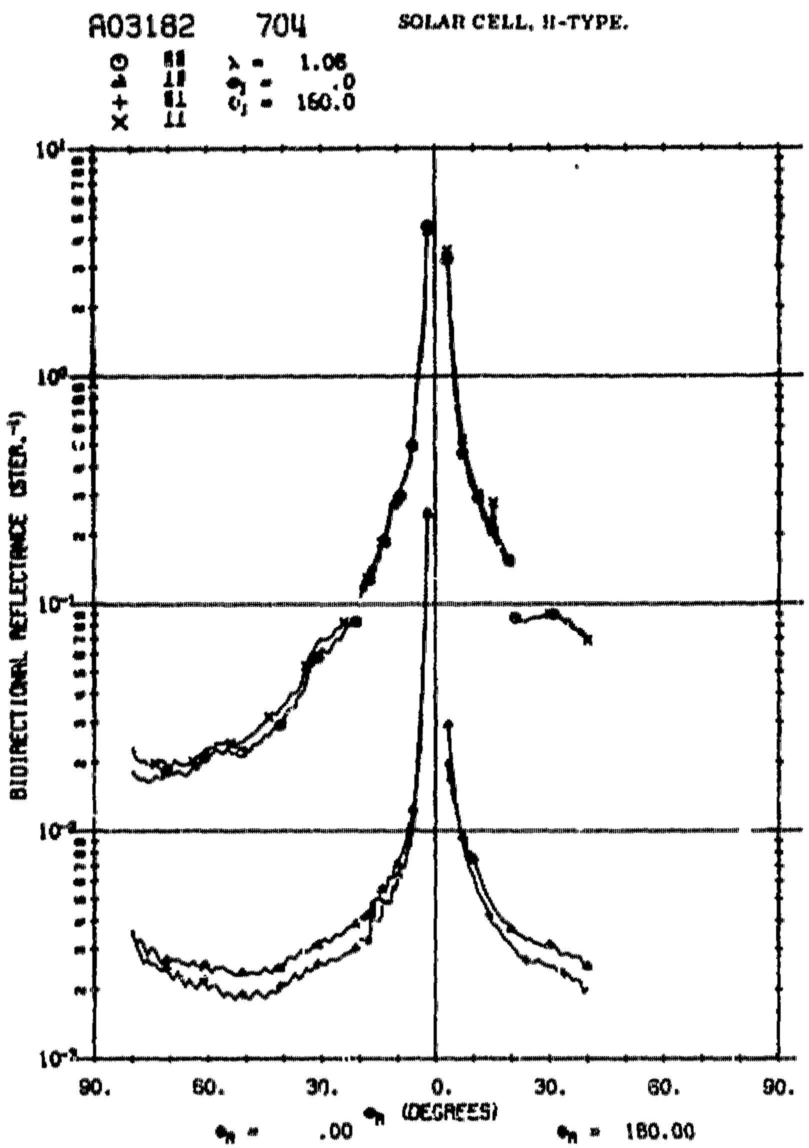

A03182 702 SOLAR CELL, H-TYPE.
λ = .55
θᵢ = .0
φᵢ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θ_R (DEGREES)
φ_R = .00
φ_R = 180.00

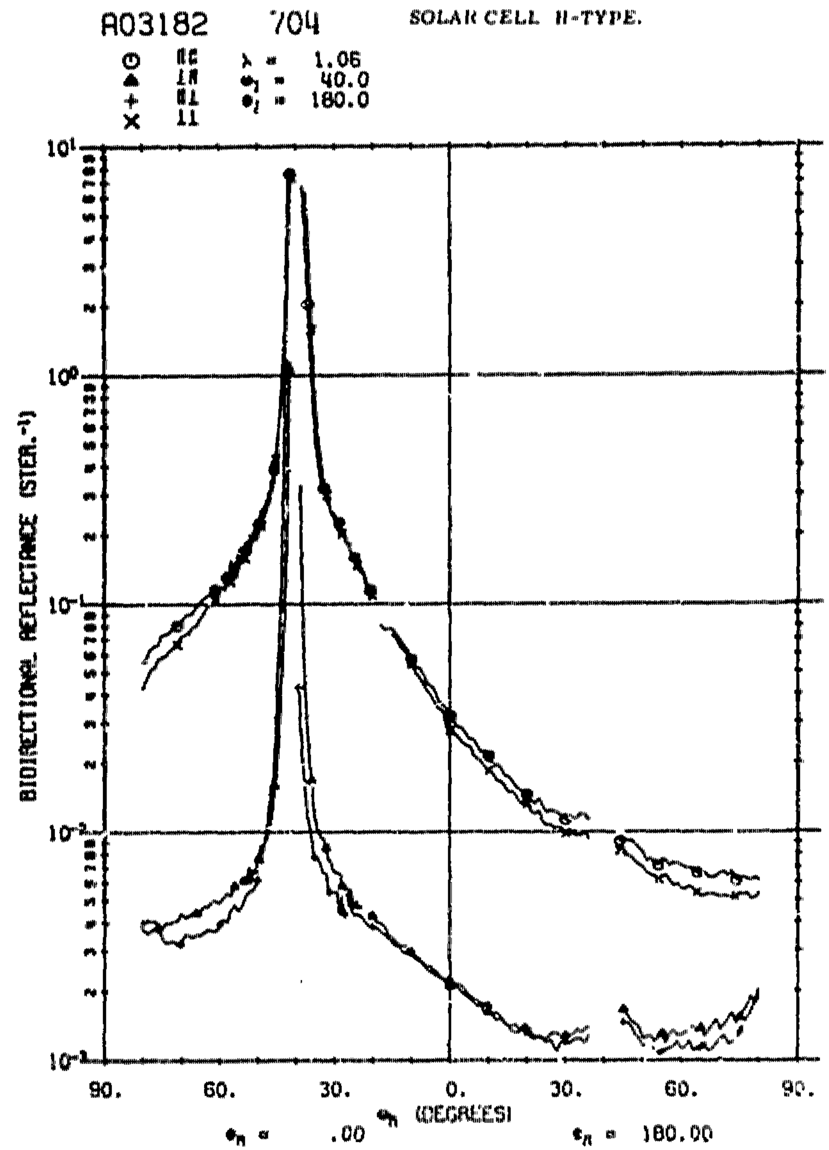


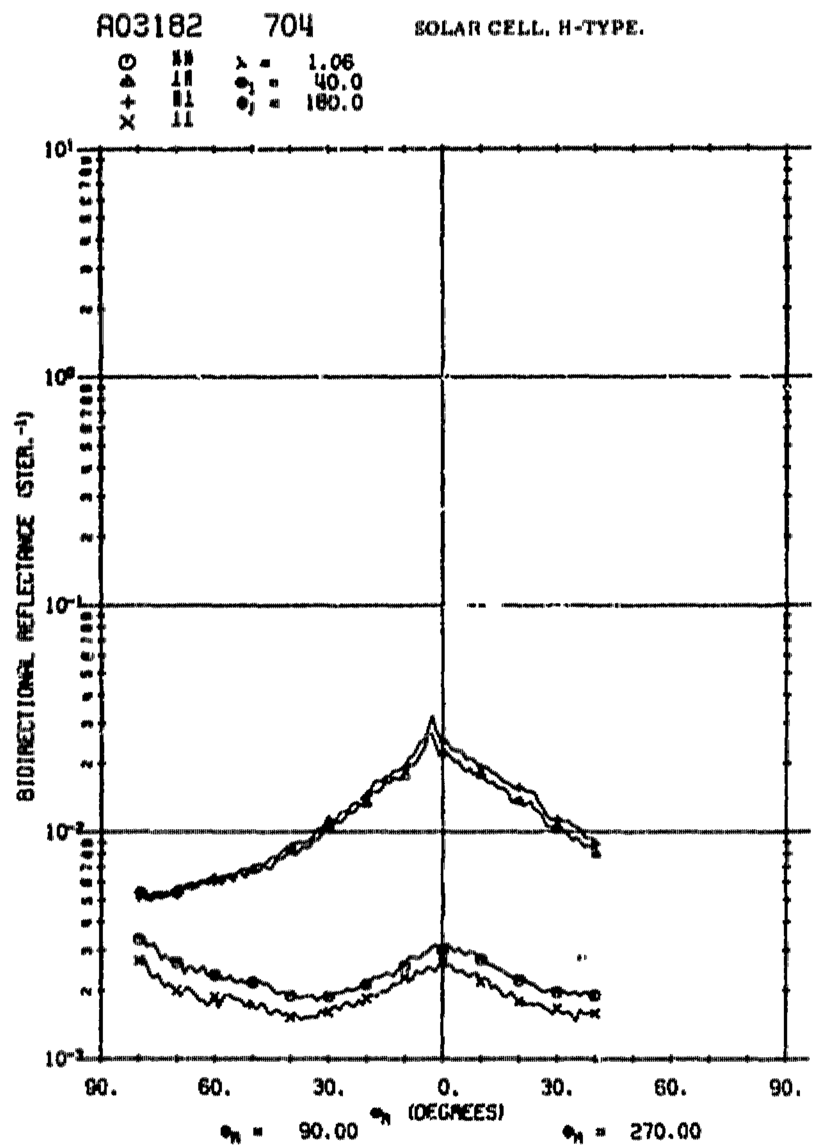
A03182 702 SOLAR CELL. II-TYPE.
0∥
0⊥
λ = .55
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00
φR = 180.00

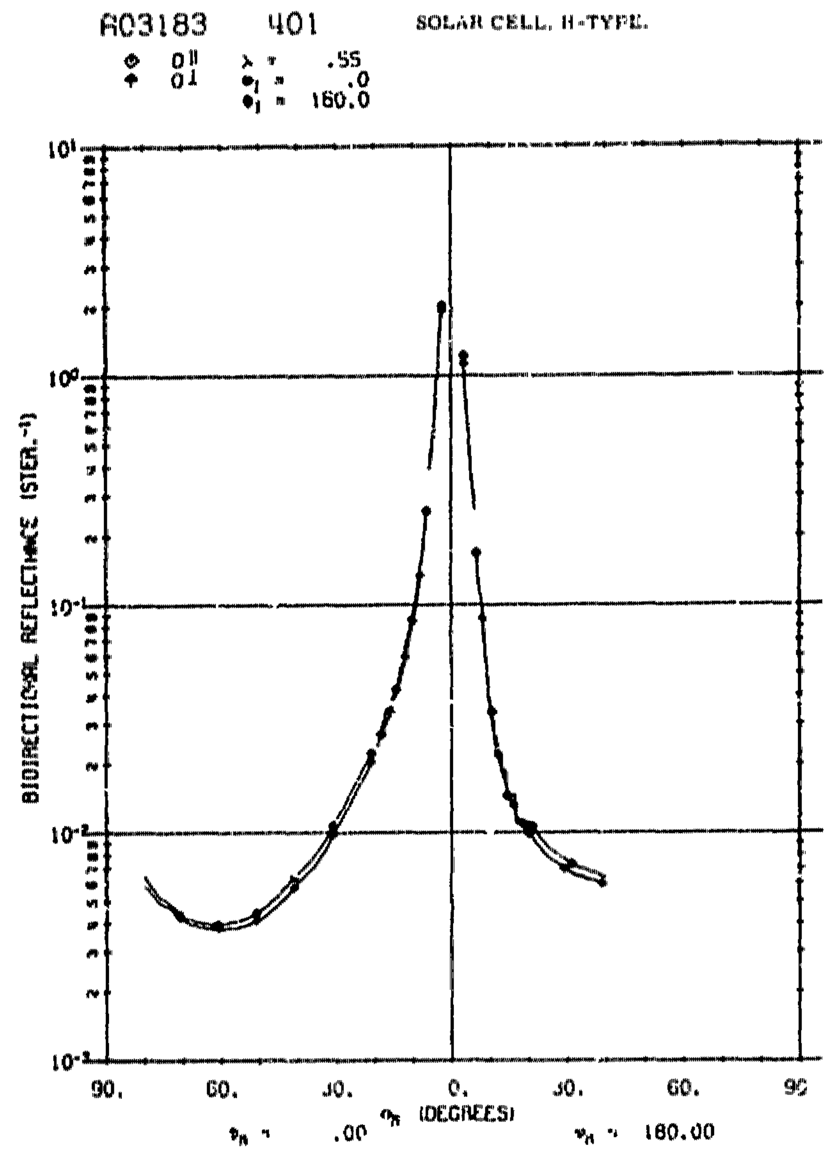


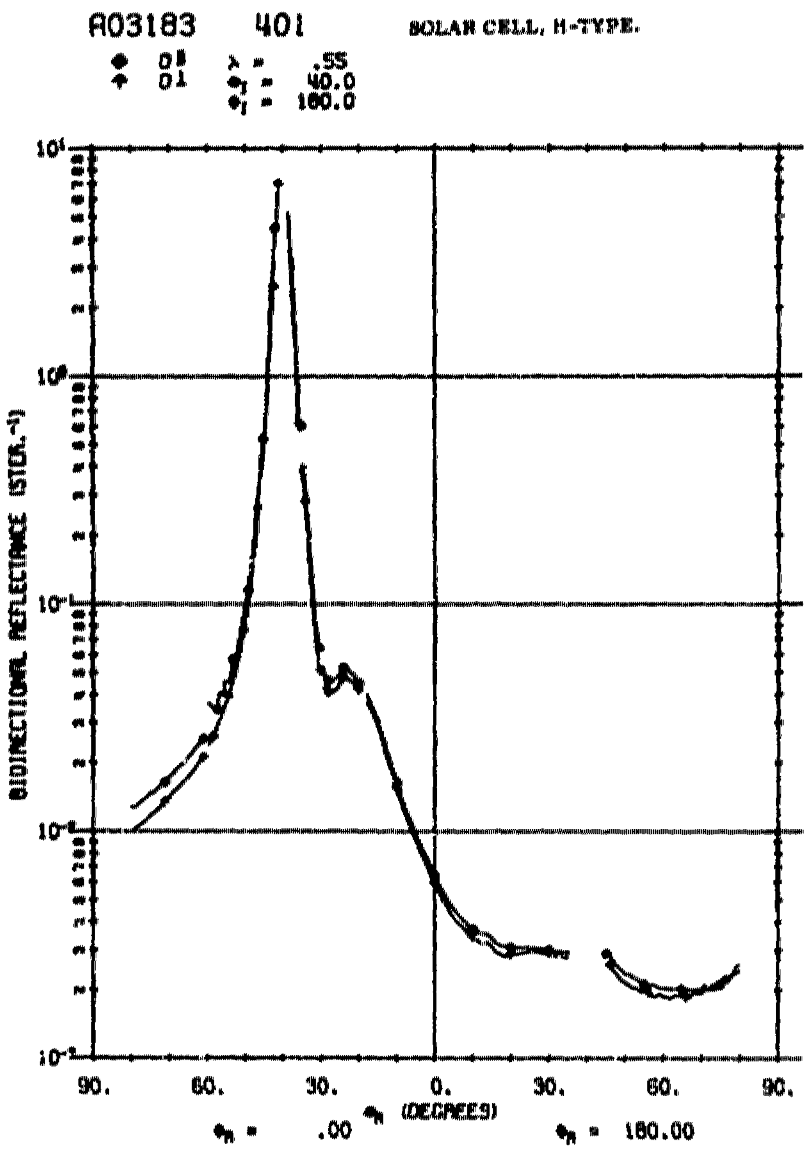
A03182 702 SOLAR CELL. II-TYPE.
0∥
0⊥
λ = .55
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)

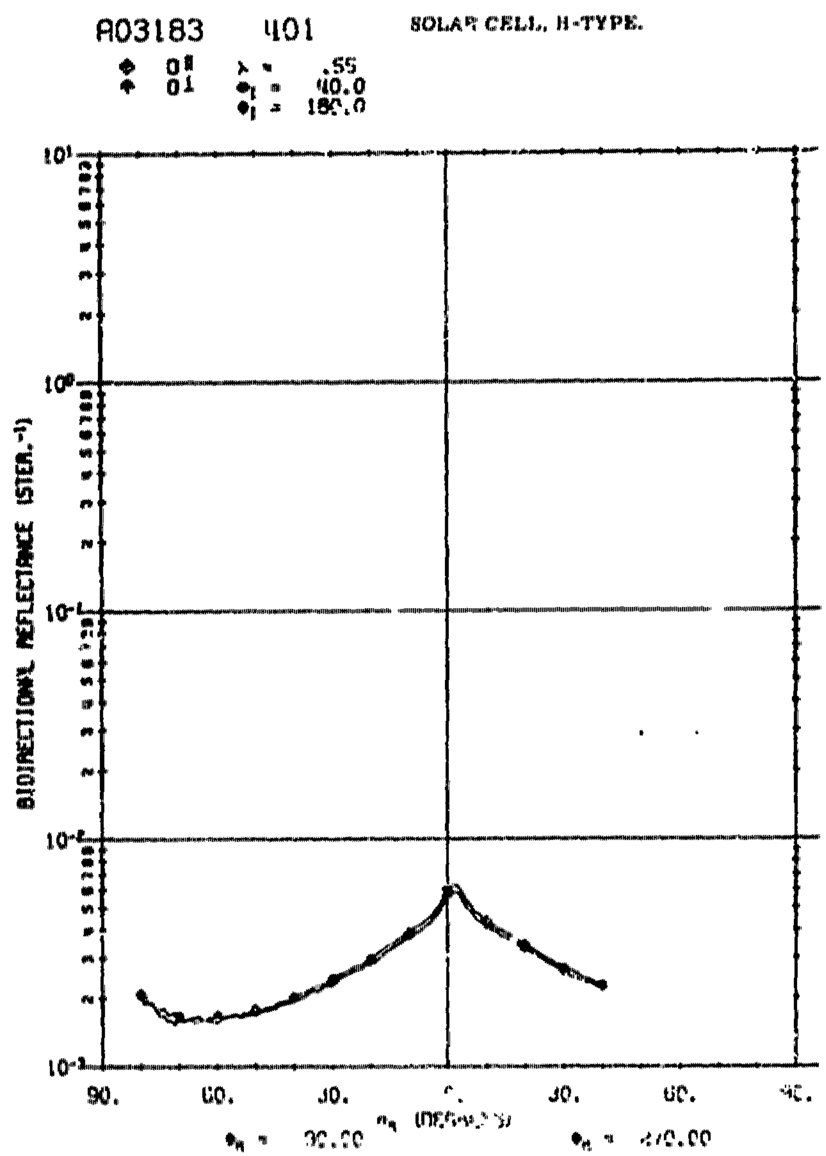

A03182 704
SOLAR CELL, II-TYPE.
λ = 1.06
.0
160.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
DEGREES
.00
180.00

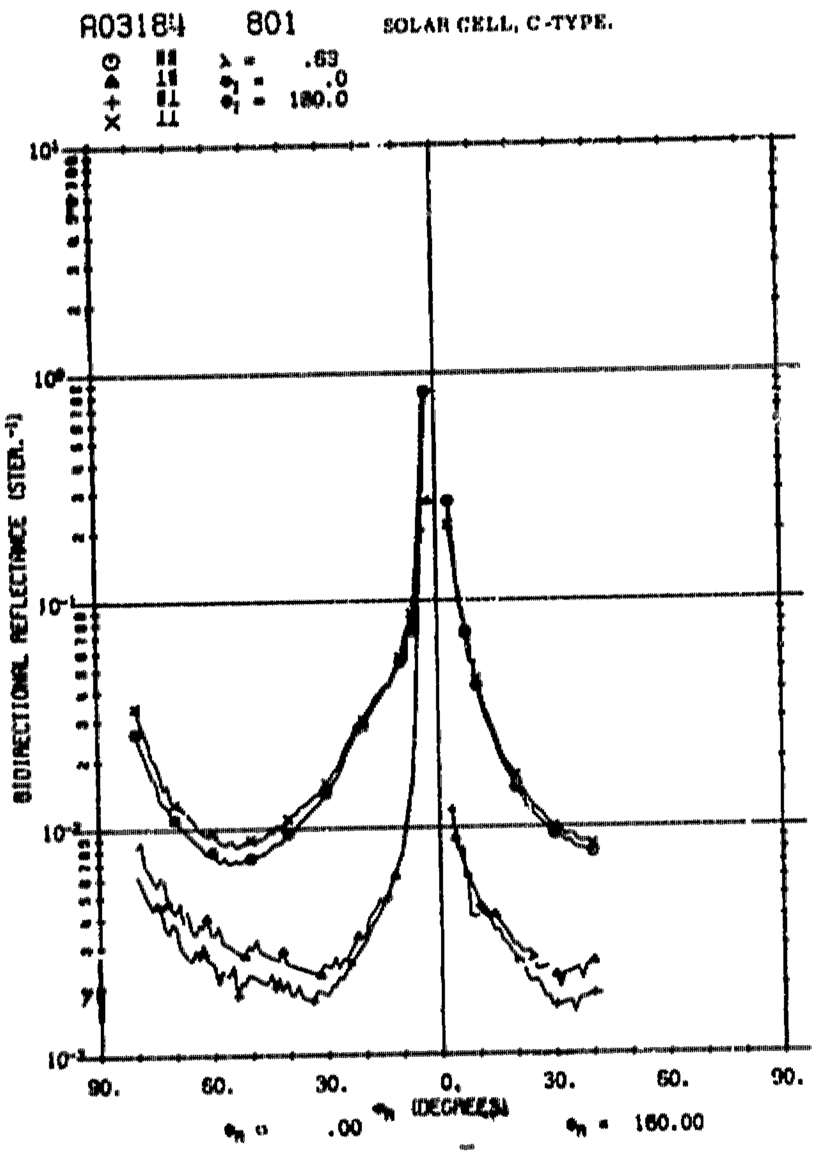

A03182 704
SOLAR CELL II-TYPE.
λ = 1.06
40.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
DEGREES
.00
180.00

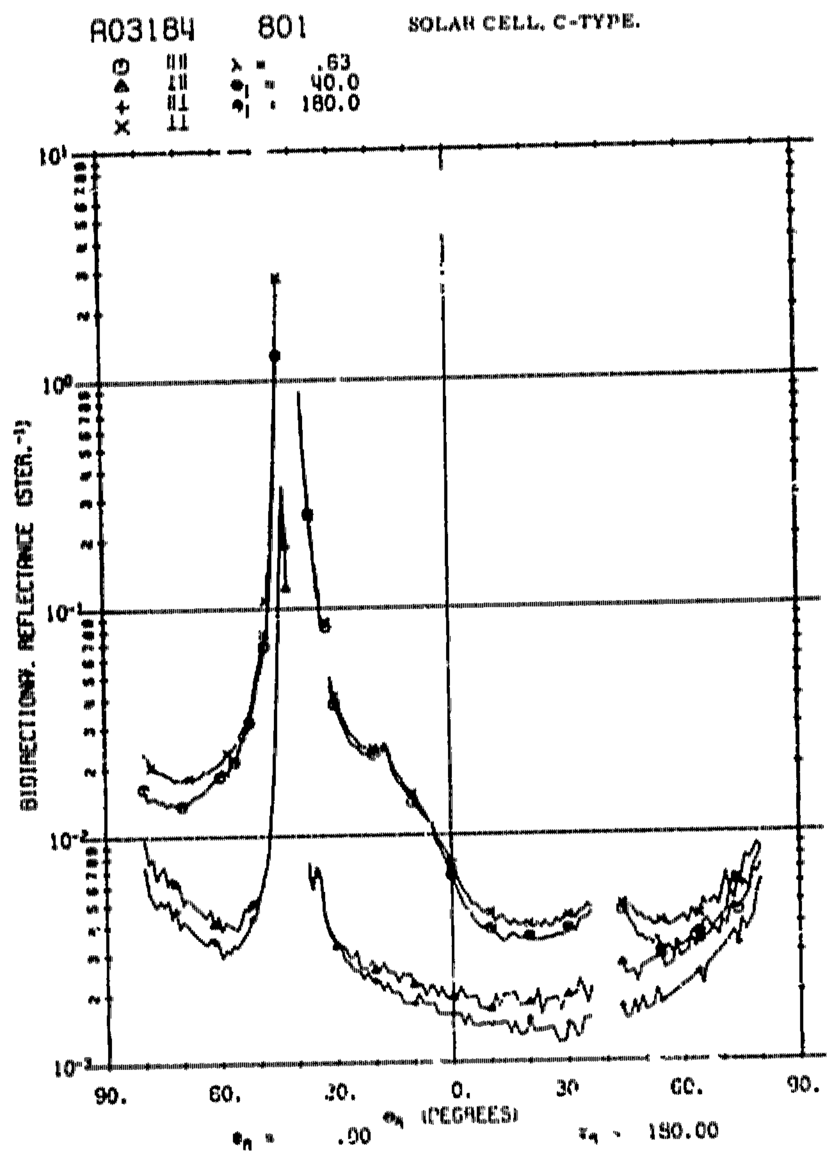

A03182 704
SOLAR CELL, H-TYPE.
λ = 1.06
40.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
90.00
270.00

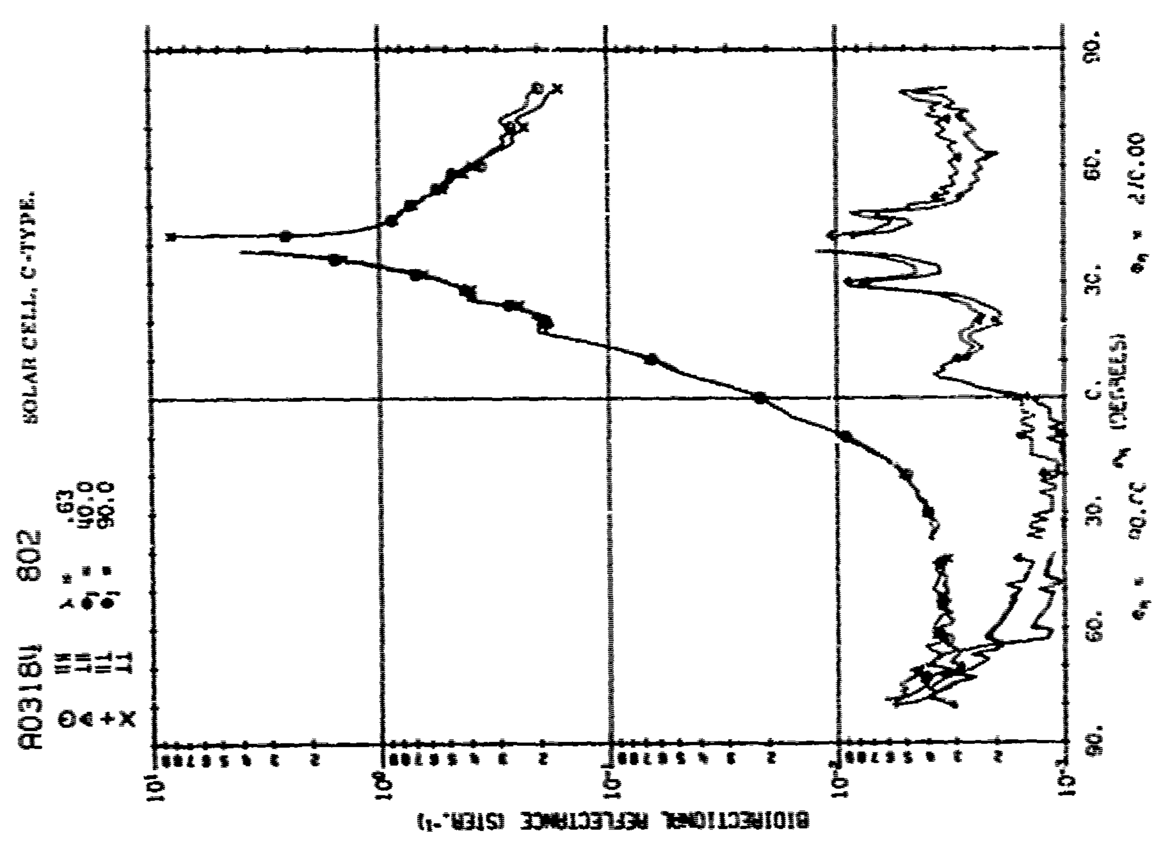

A03183 401
SOLAR CELL, H-TYPE.
λ = .55
.0
160.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
.00
180.00

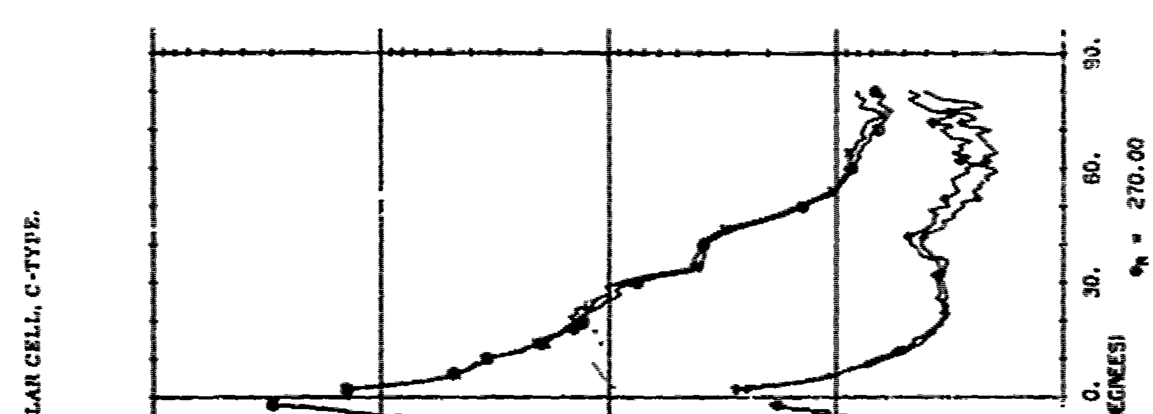

A03183 401
SOLAR CELL, H-TYPE.
0∥
0⊥
λ = .55
θI = 40.0
ΦI = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
ΦR = .00
ΦR = 180.00

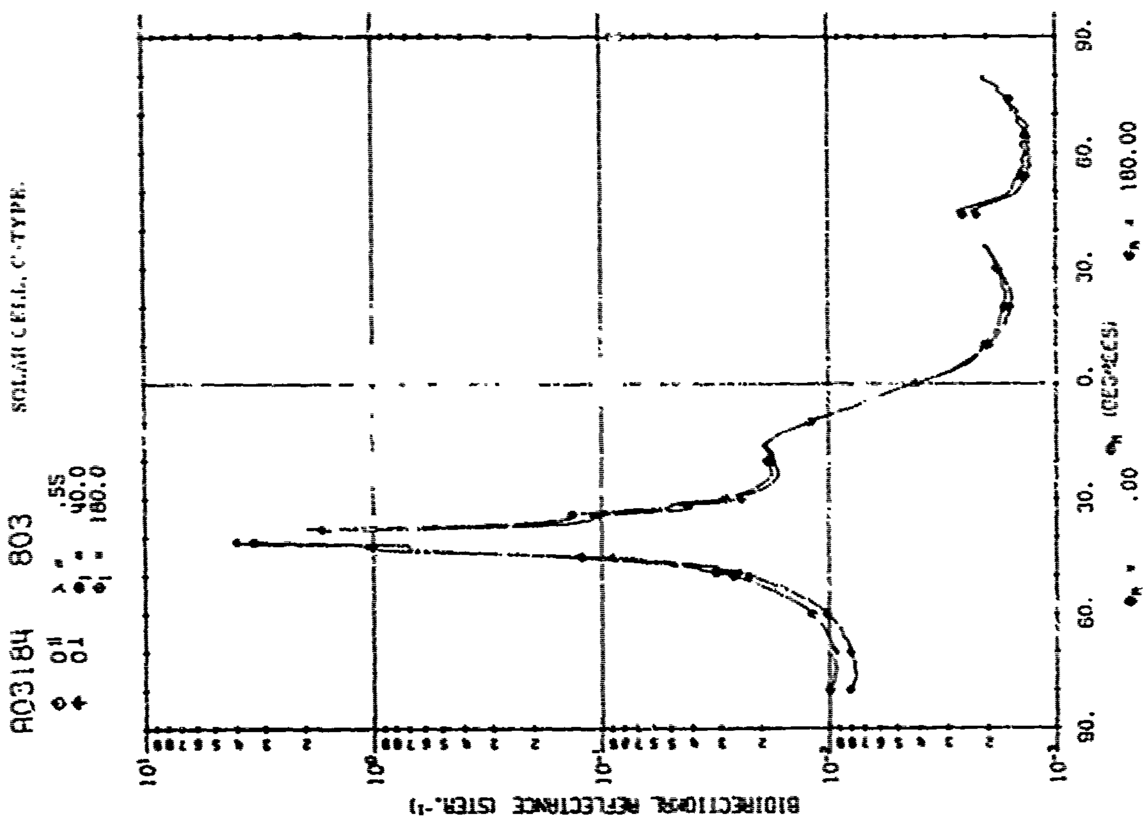

A03183 401
SOLAR CELL, H-TYPE.
0∥
0⊥
λ = .55
θI = 40.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)

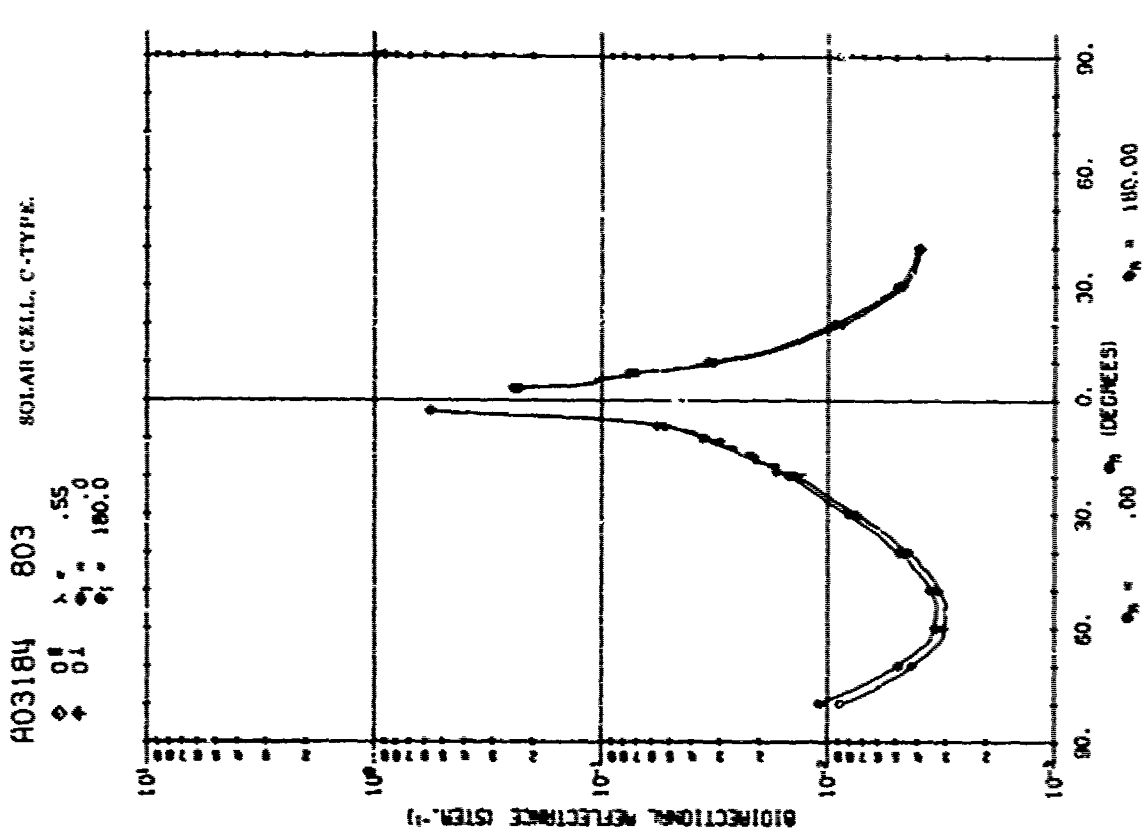

A03184 801 SOLAR CELL, C-TYPE.
λ = .63
θi = .0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
90. 60. 30. 0. 30. 60. 90.
φn = .00 θn (DEGREES) φn = 180.00

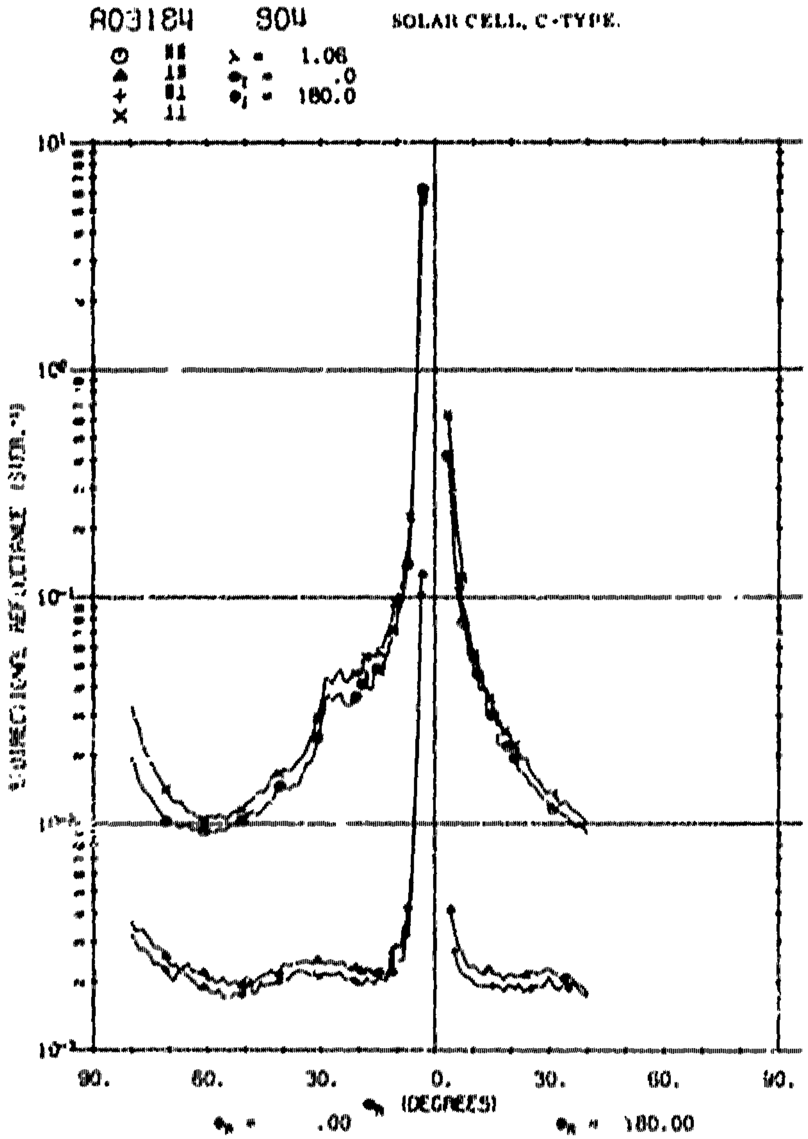

A03184 801 SOLAR CELL, C-TYPE.
λ = .63
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
90. 60. 30. 0. 30 60. 90.
φn = .00 θn (DEGREES) φn = 180.00

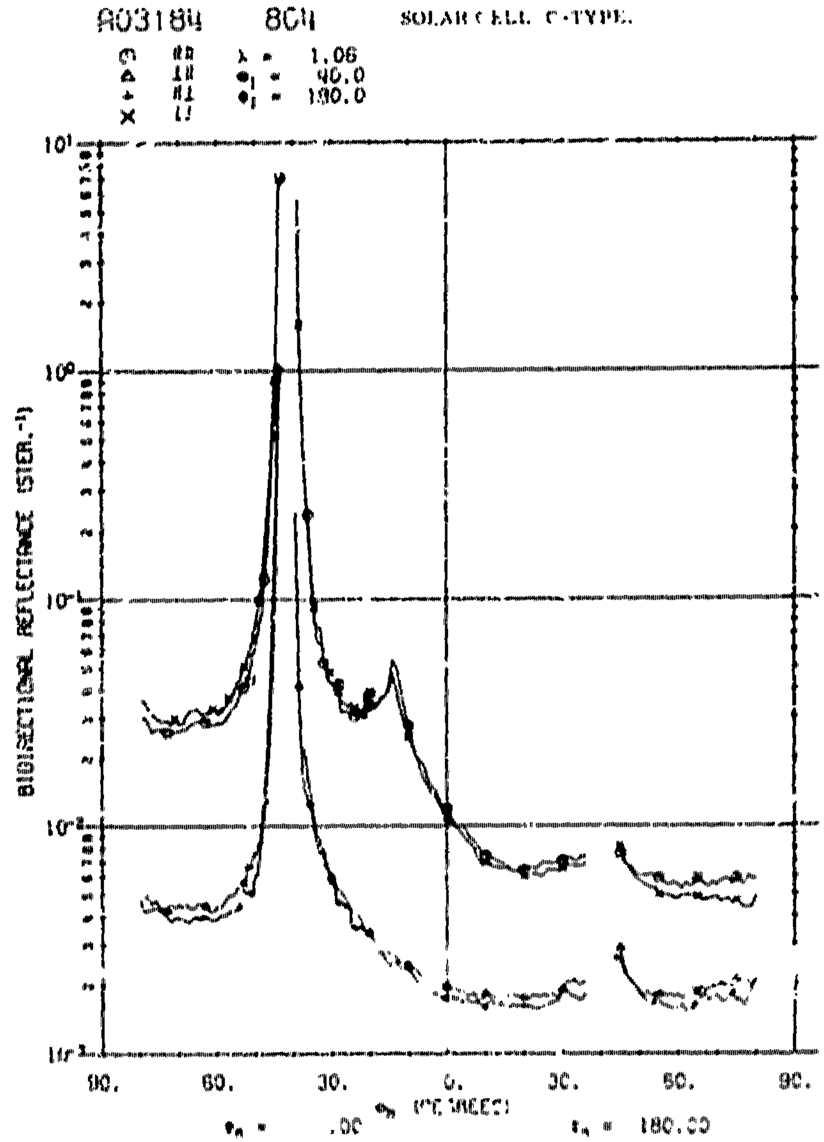

A03184
802
SOLAR CELL, C-TYPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
(DEGREES)

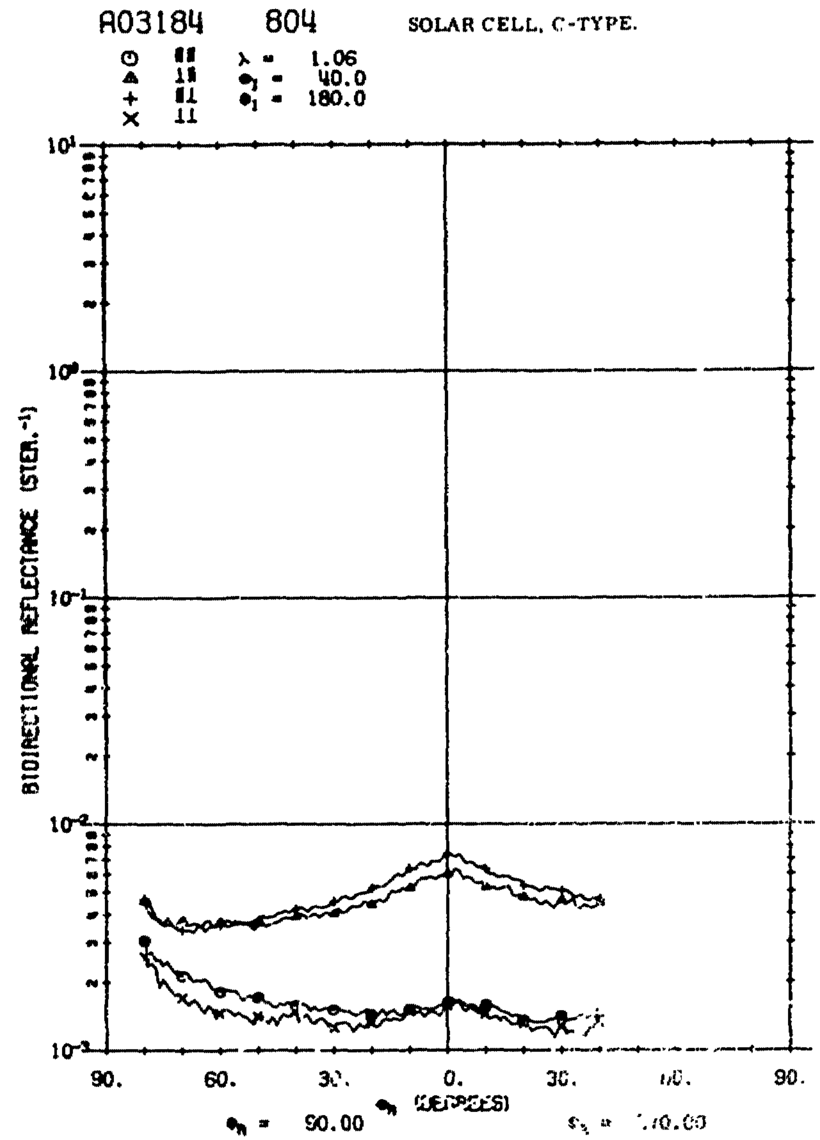

A03184
802
.63
90.0
SOLAR CELL, C-TYPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
(DEGREES)
270.00

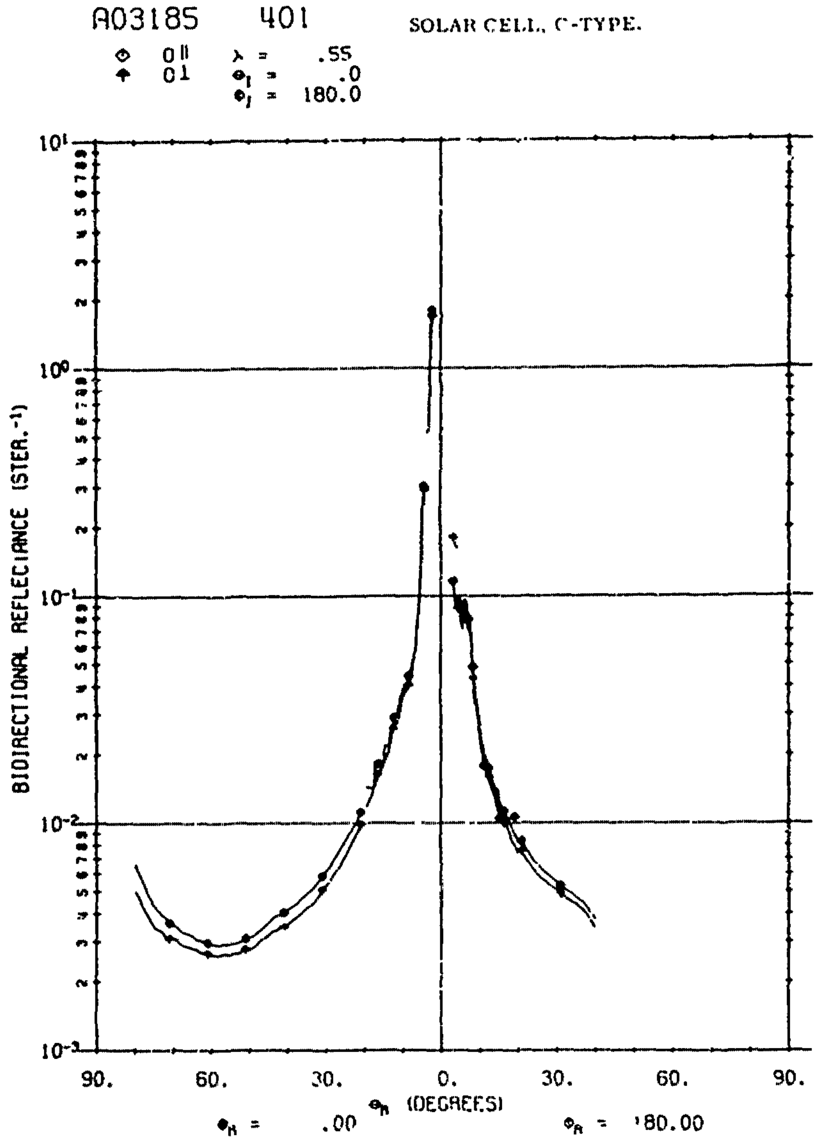

A03184 803
◇ 01 λ = .55
◆ 01 θi = 40.0
φi = 180.0
SOLAR CELL, C-TYPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00 φR = 180.00

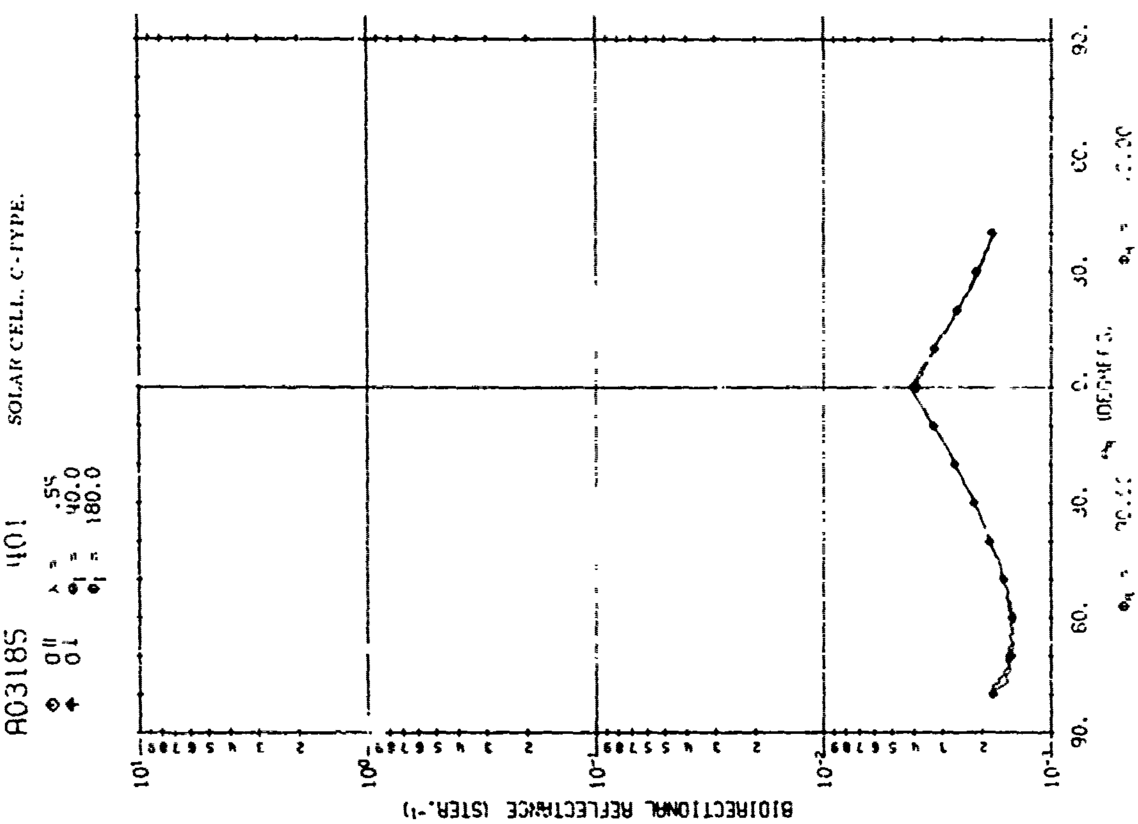

A03184 803
◇ 01 λ = .55
◆ 01 θi = .0
φi = 180.0
SOLAR CELL, C-TYPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00 φR = 180.00


A03184 90U SOLAR CELL, C-TYPE.
λ = 1.06
θ_I = .0
φ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
φ_R = .00
θ_R (DEGREES)
φ_R = 180.00

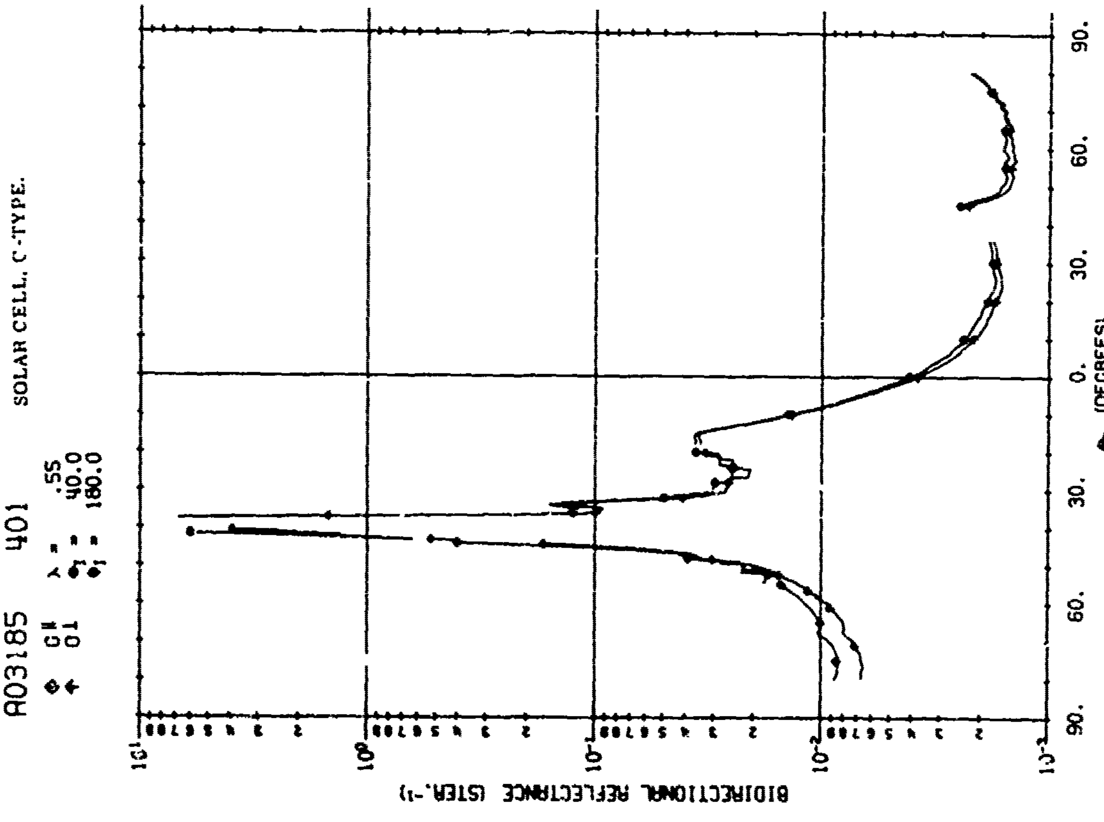

A03184 80U SOLAR CELL, C-TYPE.
λ = 1.06
θ_I = 40.0
φ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
φ_R = .00
θ_R (DEGREES)
φ_R = 180.00


A03184 804
SOLAR CELL, C-TYPE.
λ = 1.06
Θ_I = 40.0
Φ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
90. 60. 30. 0. 30. 90.
Θ_R (DEGREES)
Φ_R = 90.00

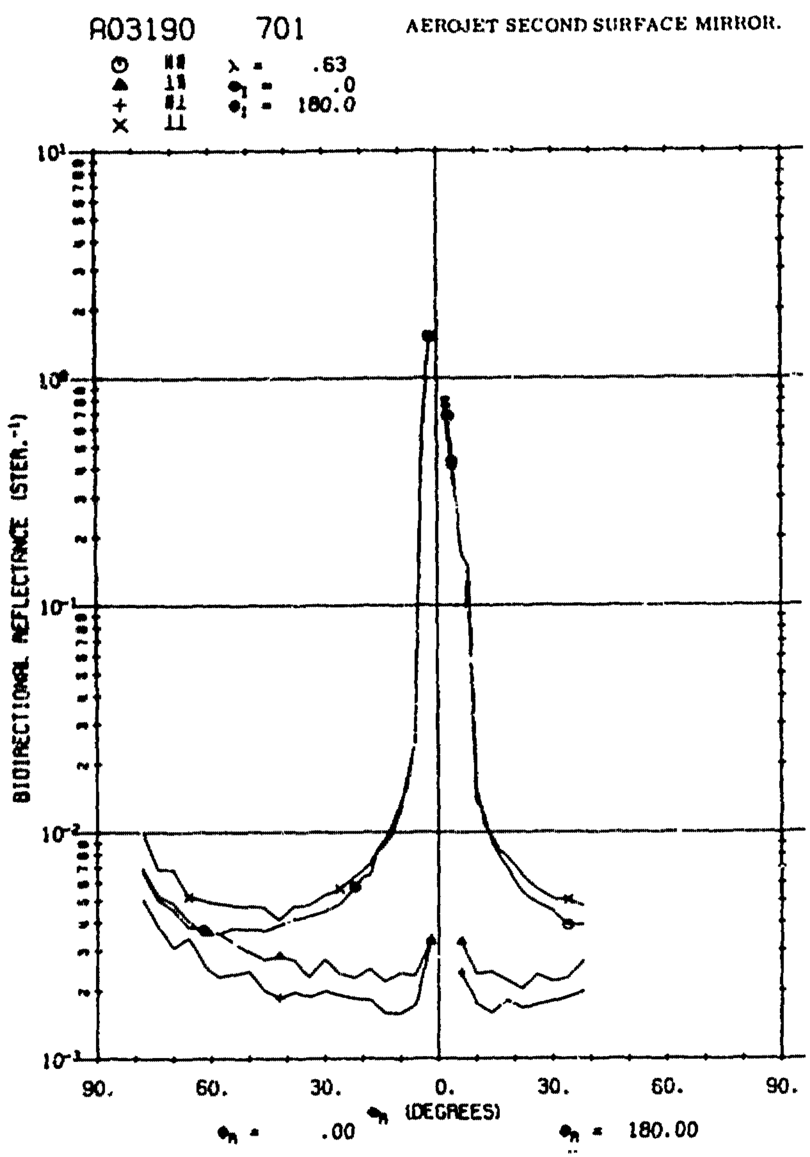

A03185 401
SOLAR CELL, C-TYPE.
λ = .55
Θ_I = .0
Φ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
90. 60. 30. 0. 30. 60. 90.
Θ_R (DEGREES)
Φ_R = .00
Φ_R = 180.00



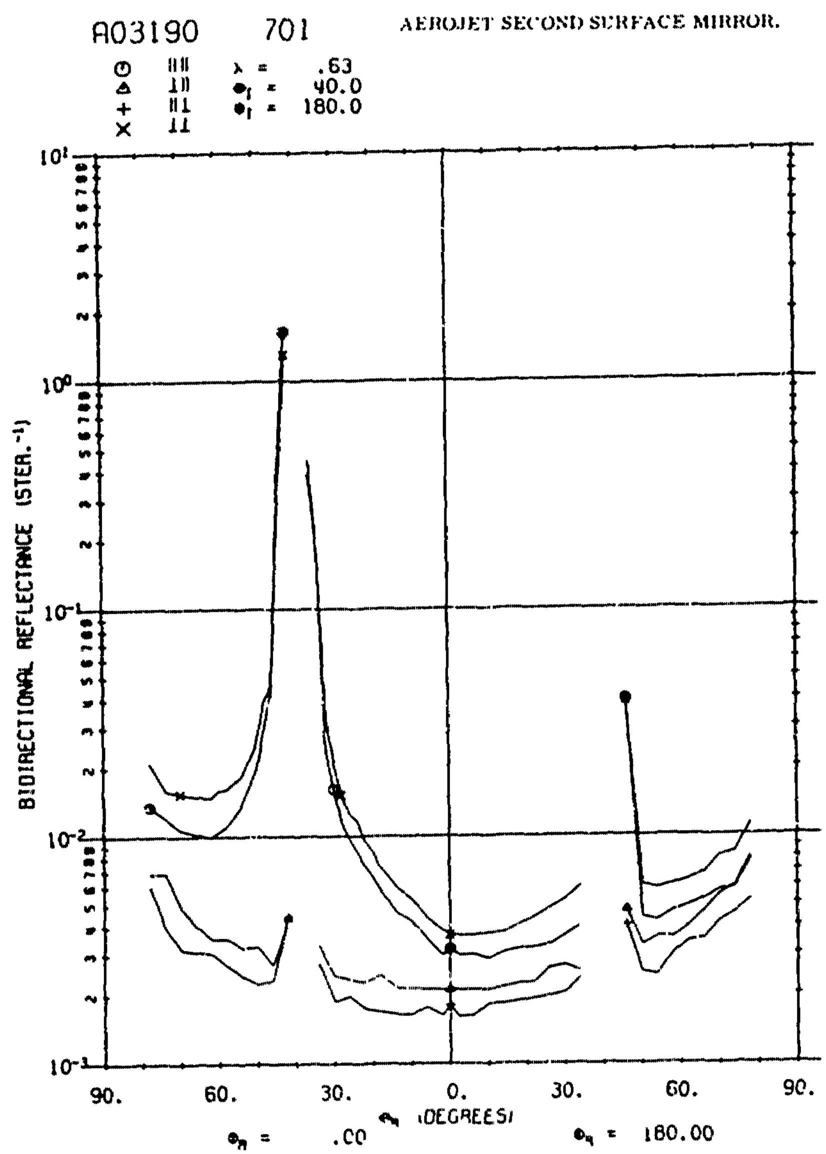
A03185 401
λ = .55
θi = 40.0
φi = 180.0
SOLAR CELL, C-TYPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
(DEGREES)



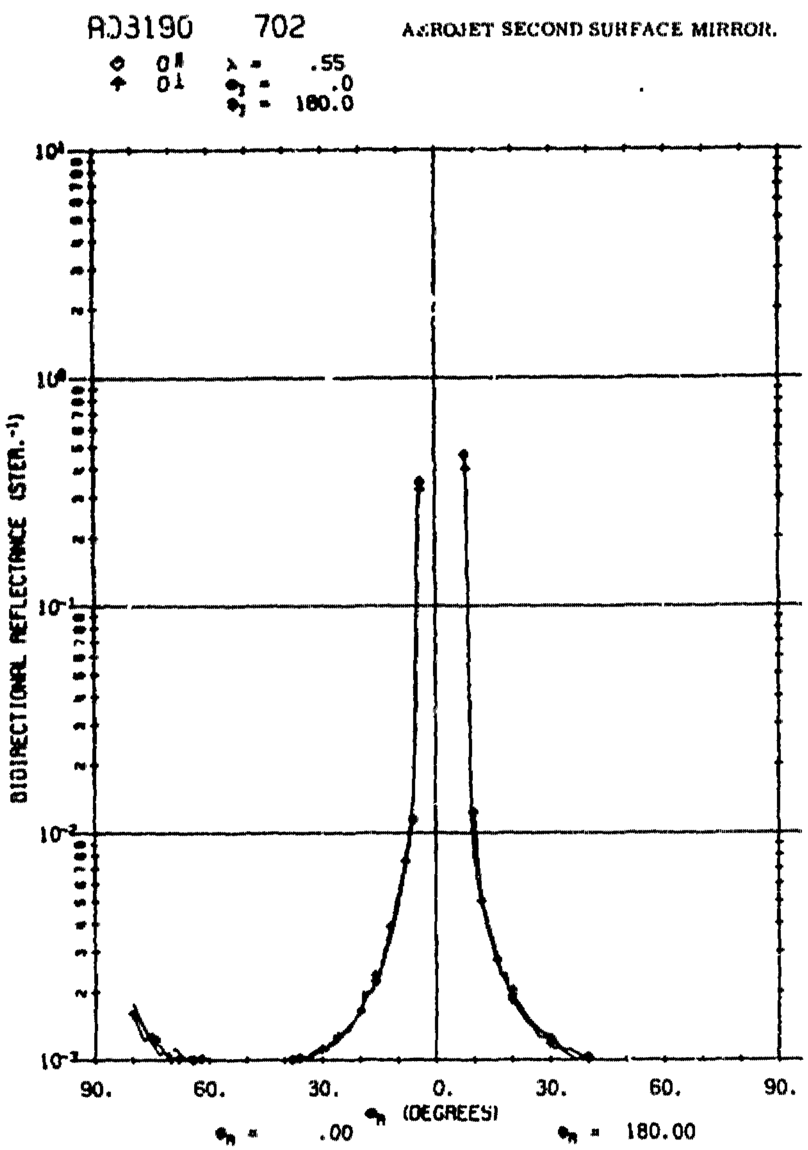
A03185 401
λ = .55
θi = 40.0
φi = 180.0
SOLAR CELL, C-TYPE.
BIDIRECTIONAL REFLECTANCE (STER.-1)
(DEGREES)
φr = .00
φr = 180.00



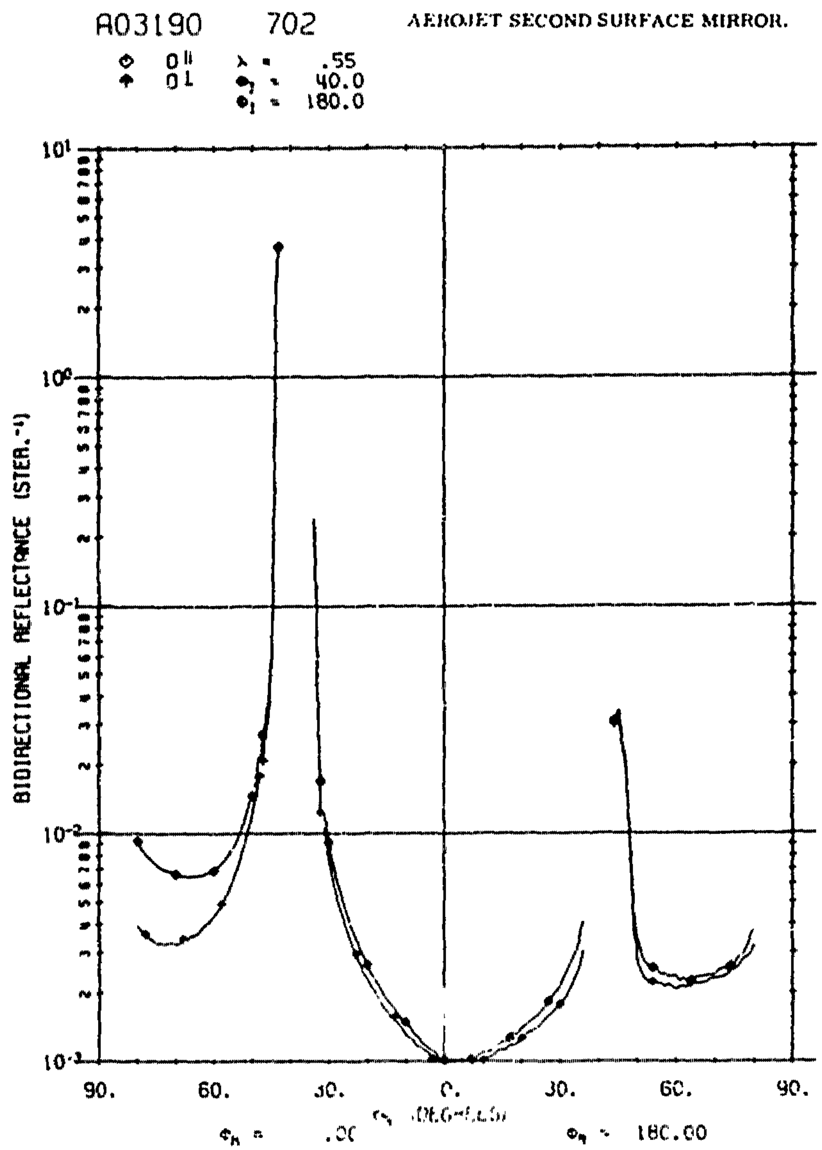
A03190 701
AEROJET SECOND SURFACE MIRROR.
λ = .63
θ_i = .0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00



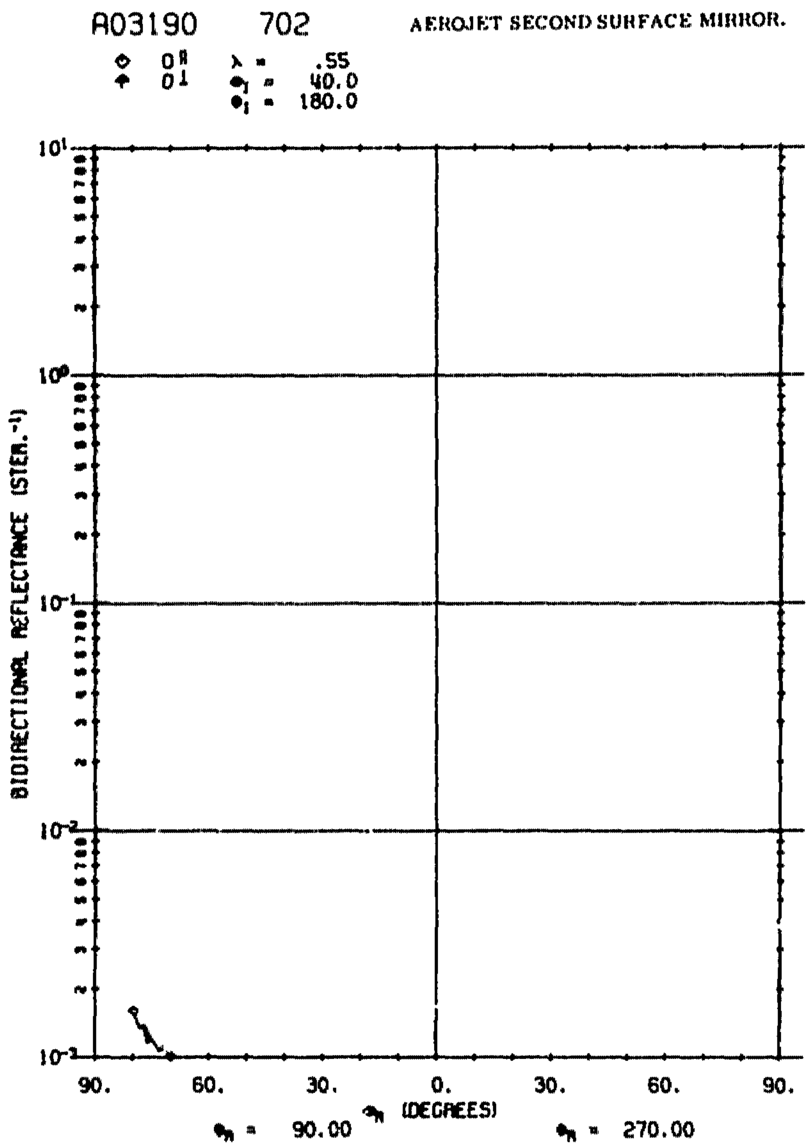
A03190 701
AEROJET SECOND SURFACE MIRROR.
λ = .63
θ_i = 40.0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00

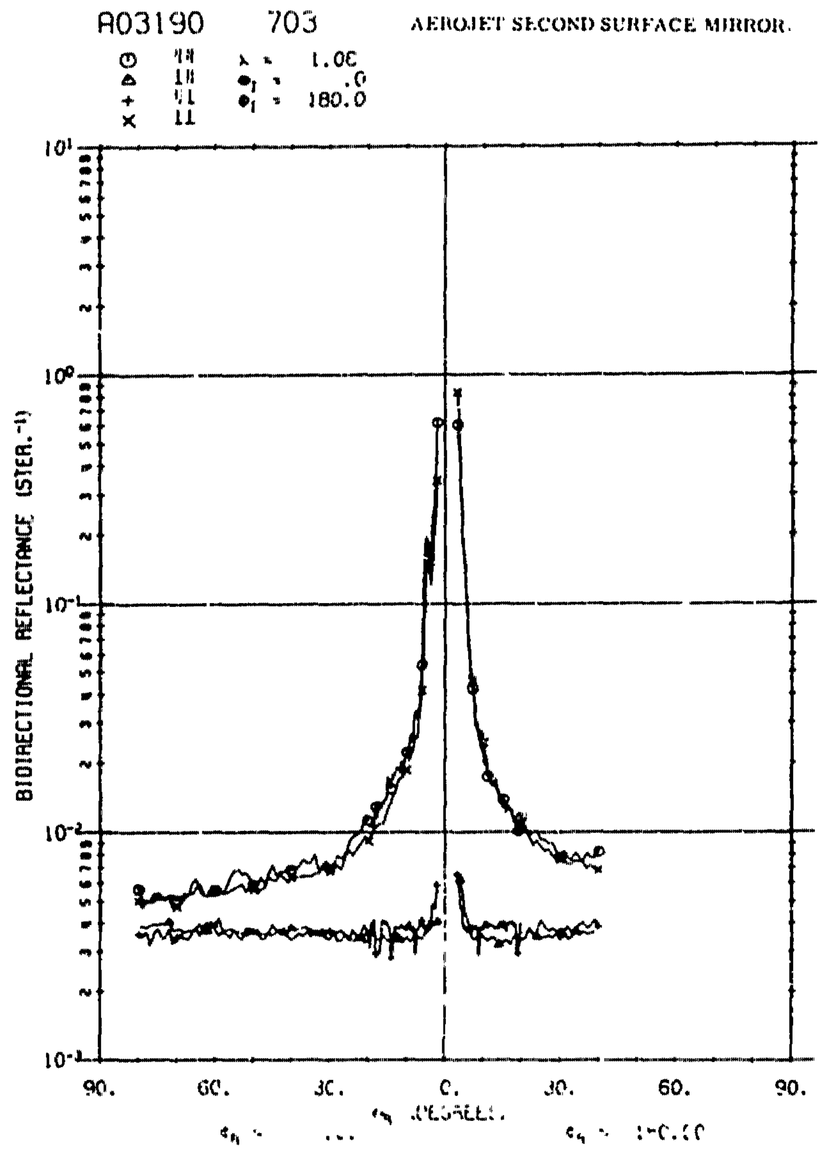


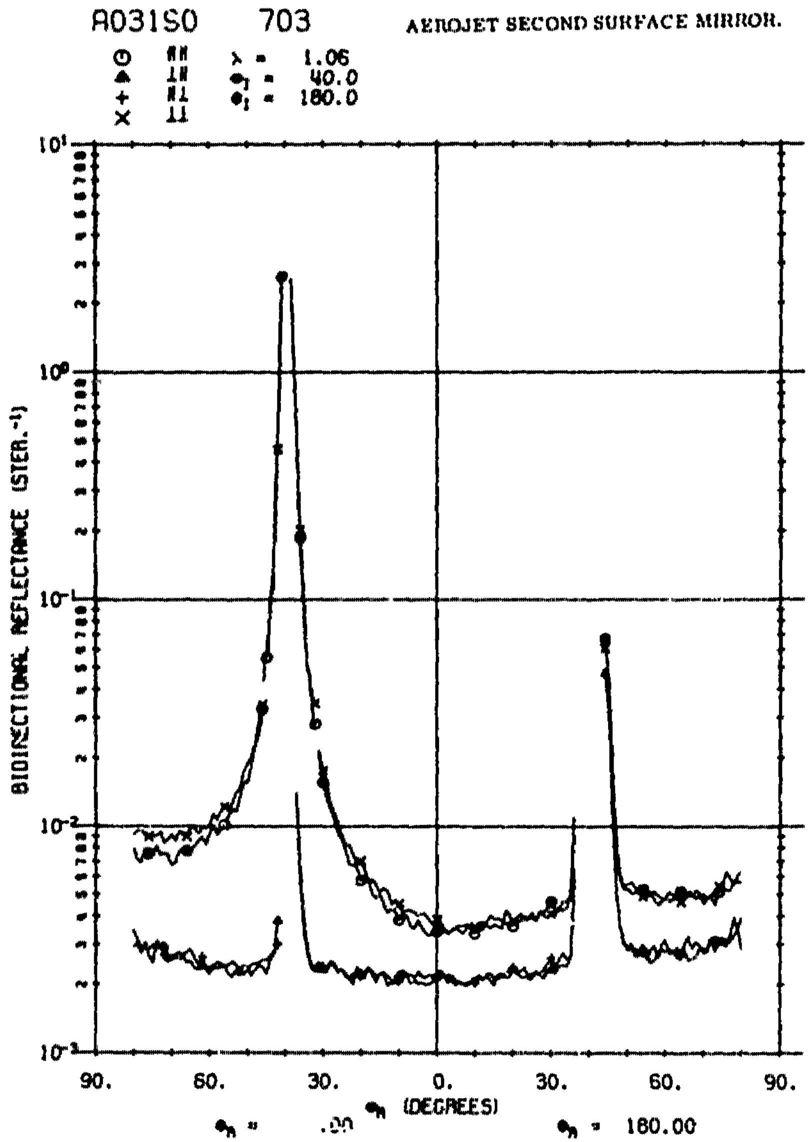
A03190 702
AEROJET SECOND SURFACE MIRROR.
0∥
0⊥
λ = .55
.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
(DEGREES)
.00
180.00

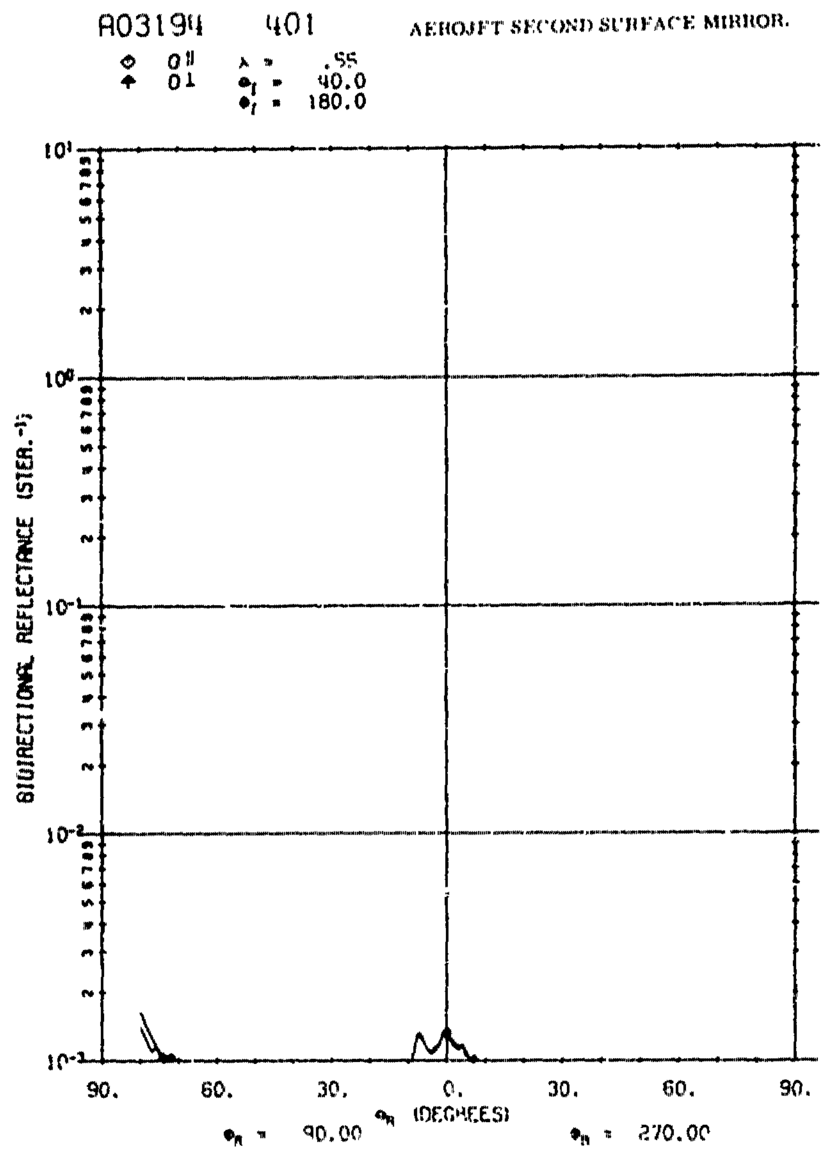


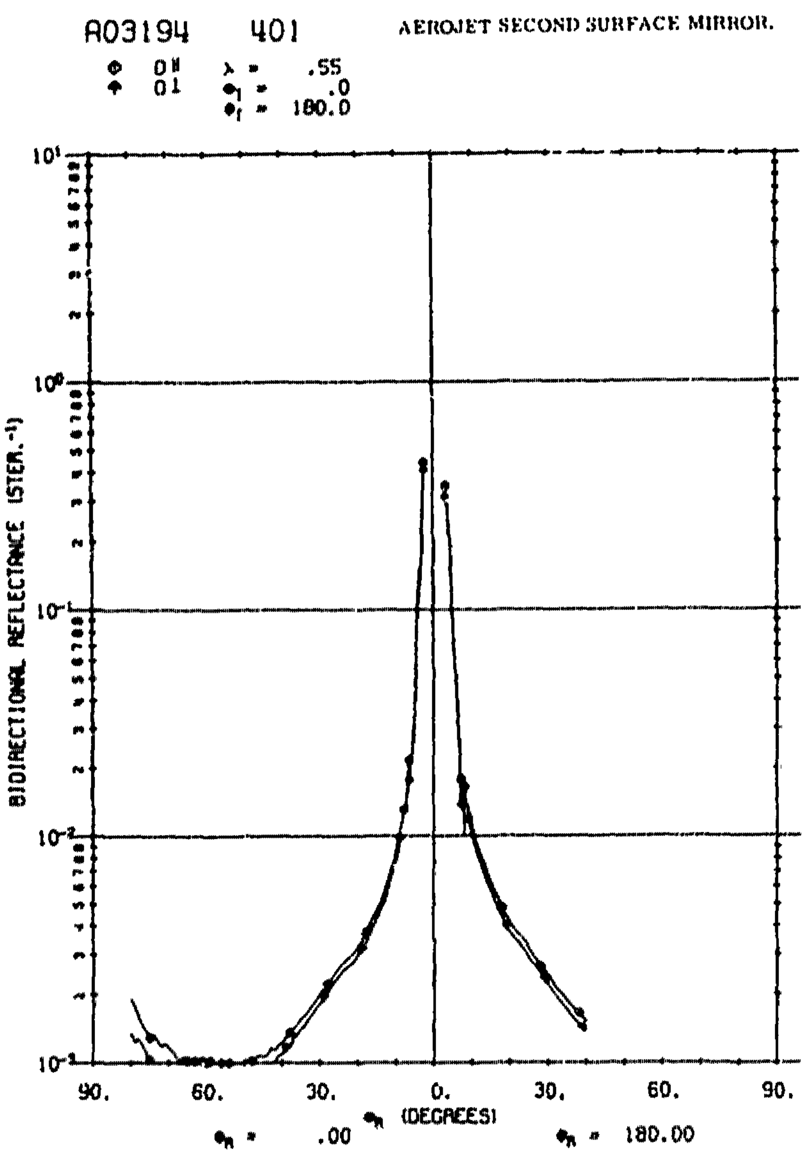
A03190 702
AEROJET SECOND SURFACE MIRROR.
0∥
0⊥
λ = .55
40.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
.00
180.00

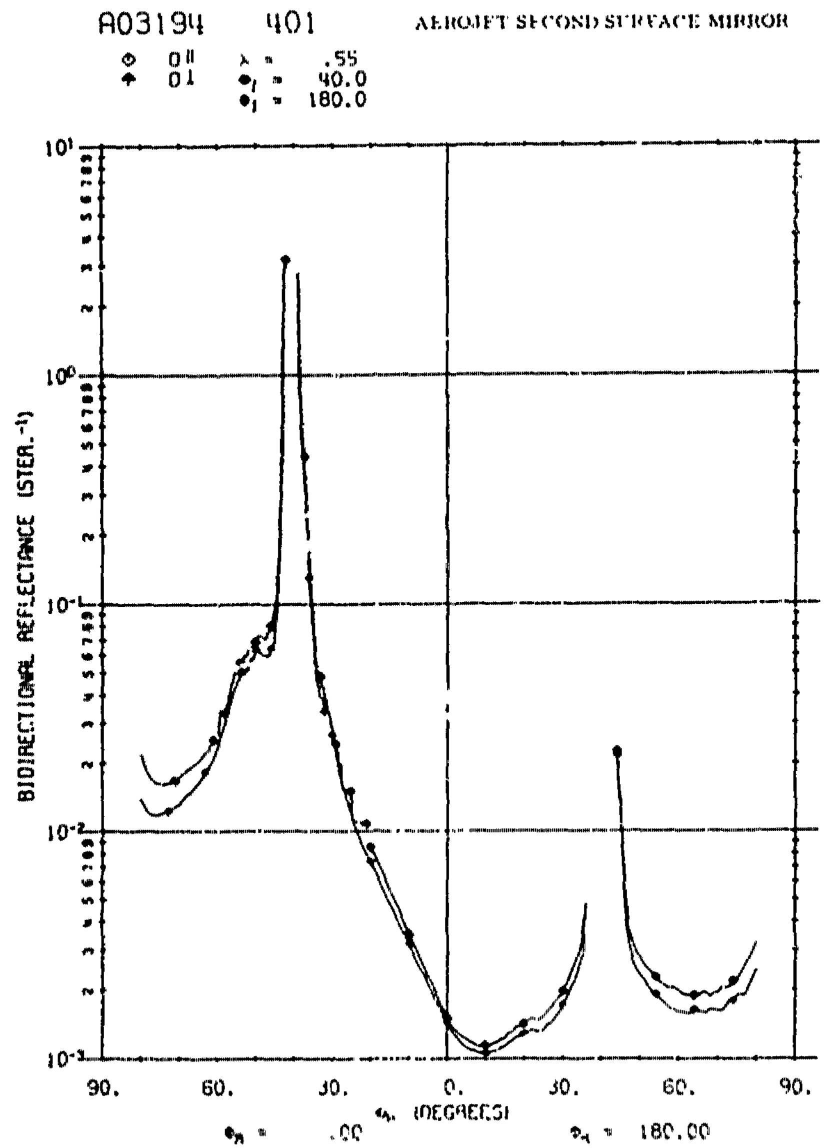

A03190 702
AEROJET SECOND SURFACE MIRROR.
λ = .55
40.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
(DEGREES)
90.00
270.00

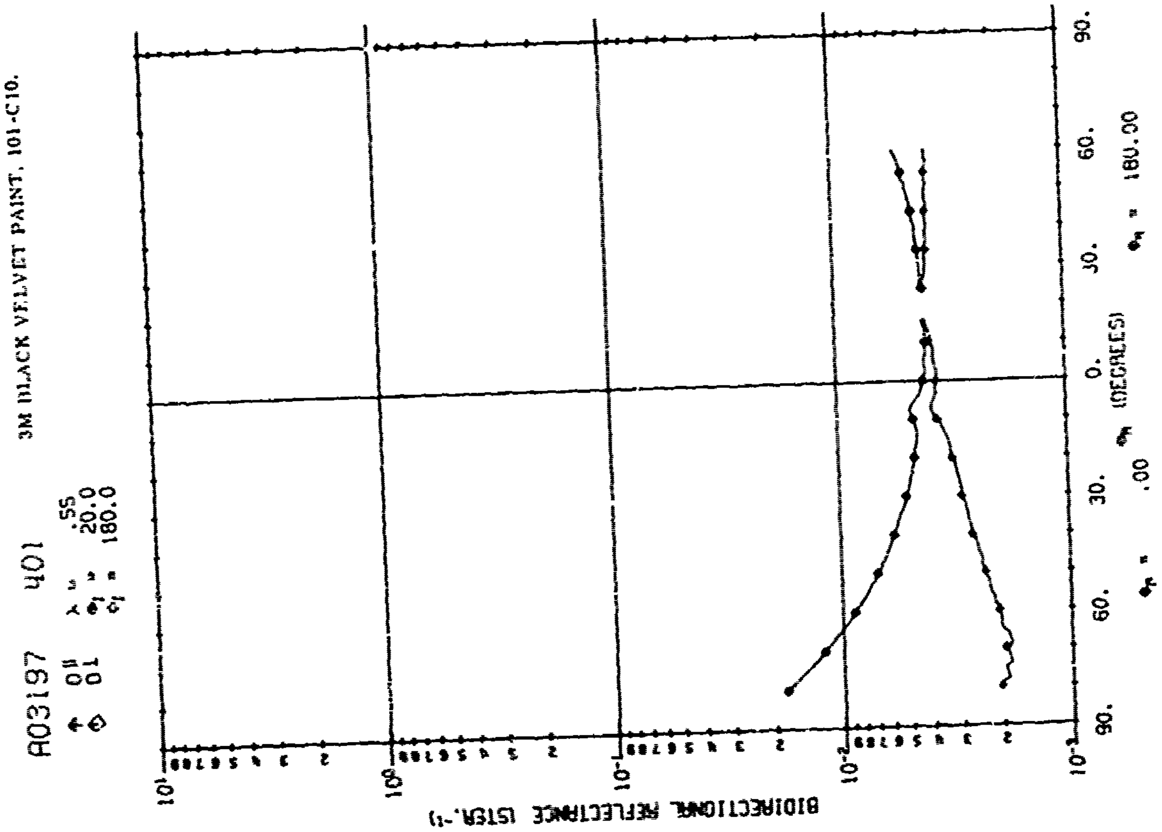

A03190 703
AEROJET SECOND SURFACE MIRROR.
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.

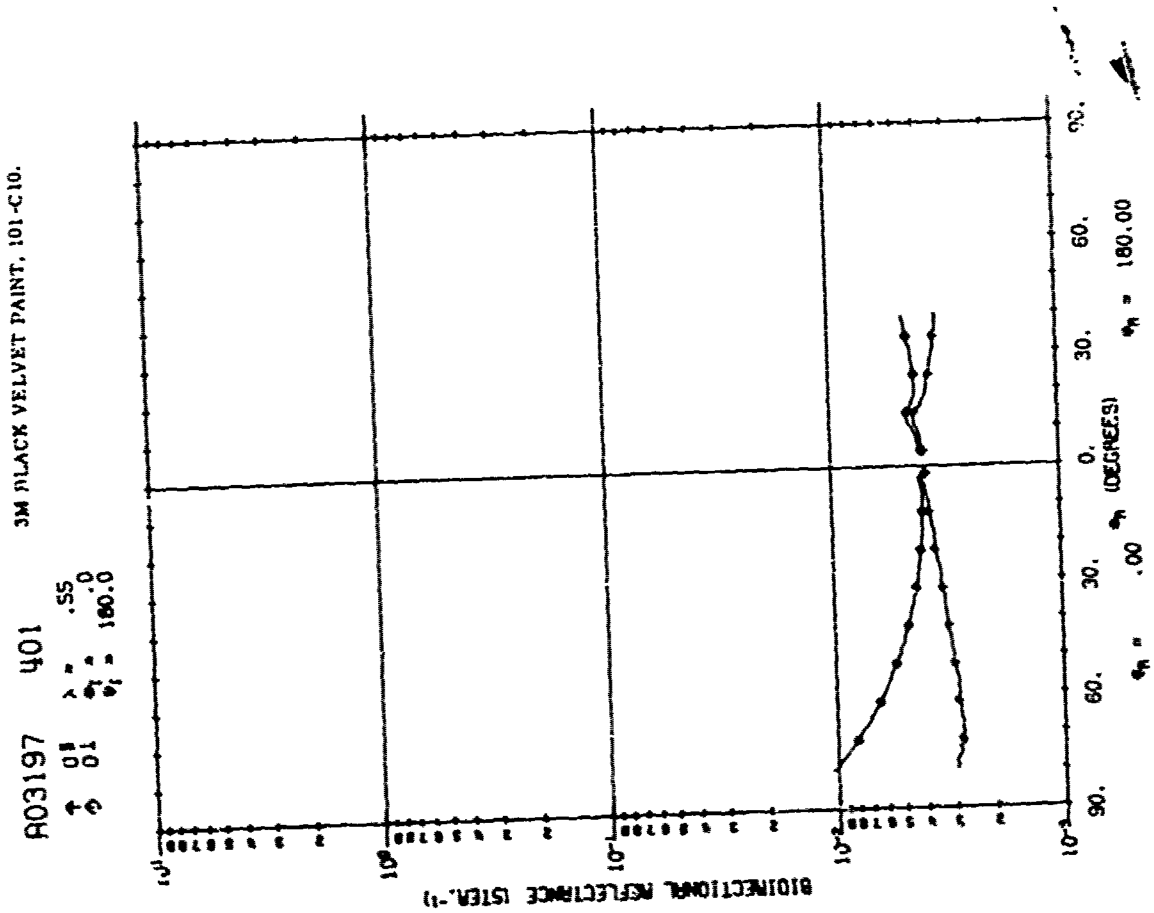

A031S0 703
AEROJET SECOND SURFACE MIRROR.
λ = 1.06
40.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
180.00

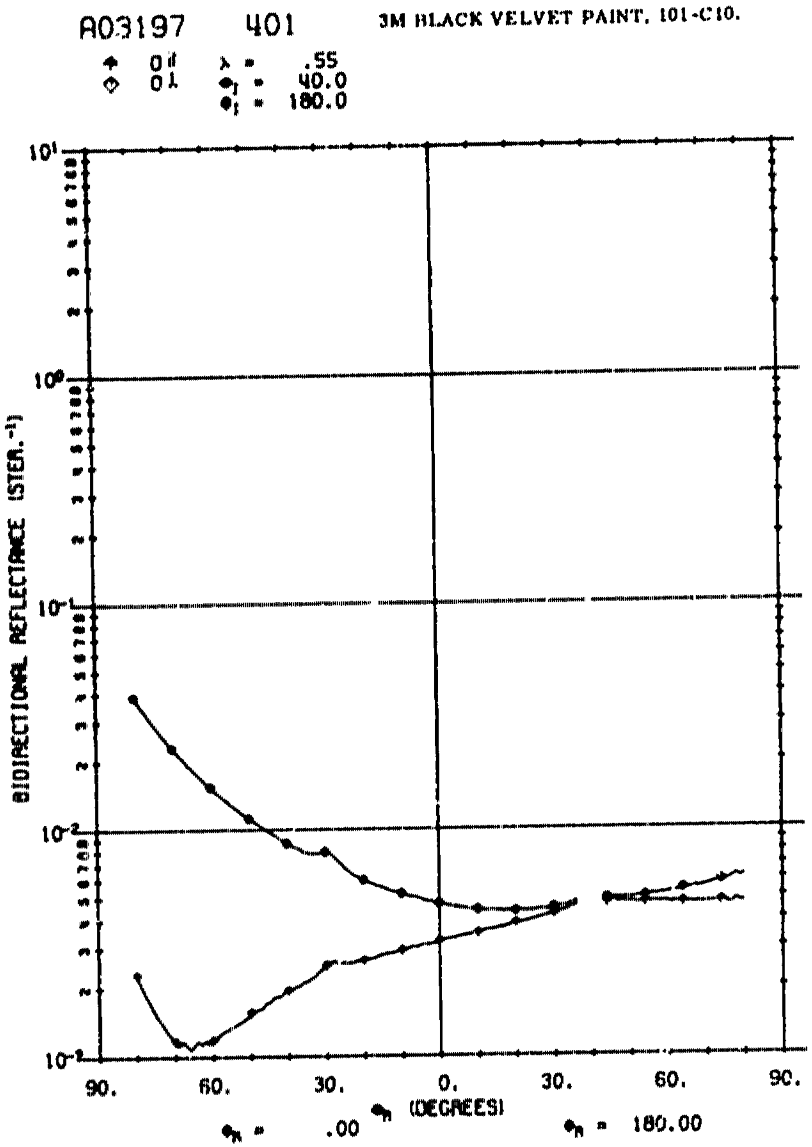

A03194 401
AEROJET SECOND SURFACE MIRROR.
λ = .55
40.0
180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
90.00
270.00

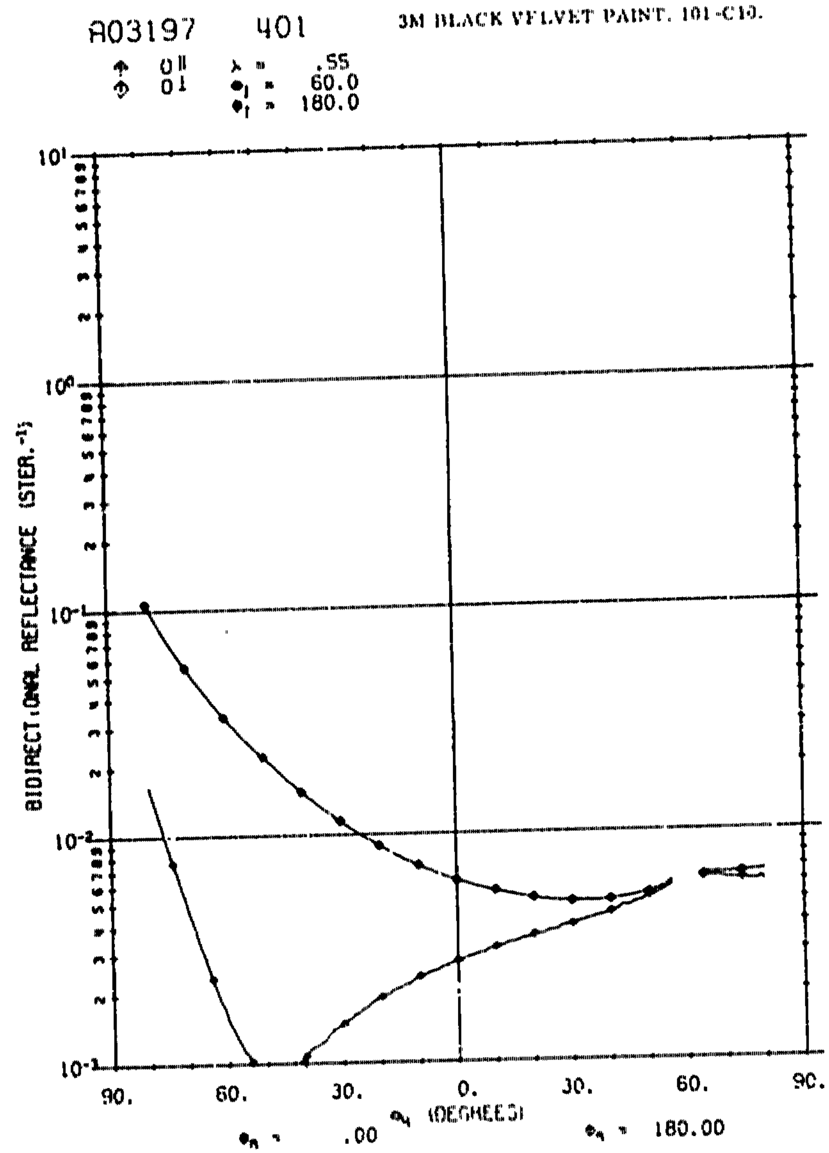

A03194 401
AEROJET SECOND SURFACE MIRROR.
0∥
0⊥
λ = .55
θ_i = .0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00

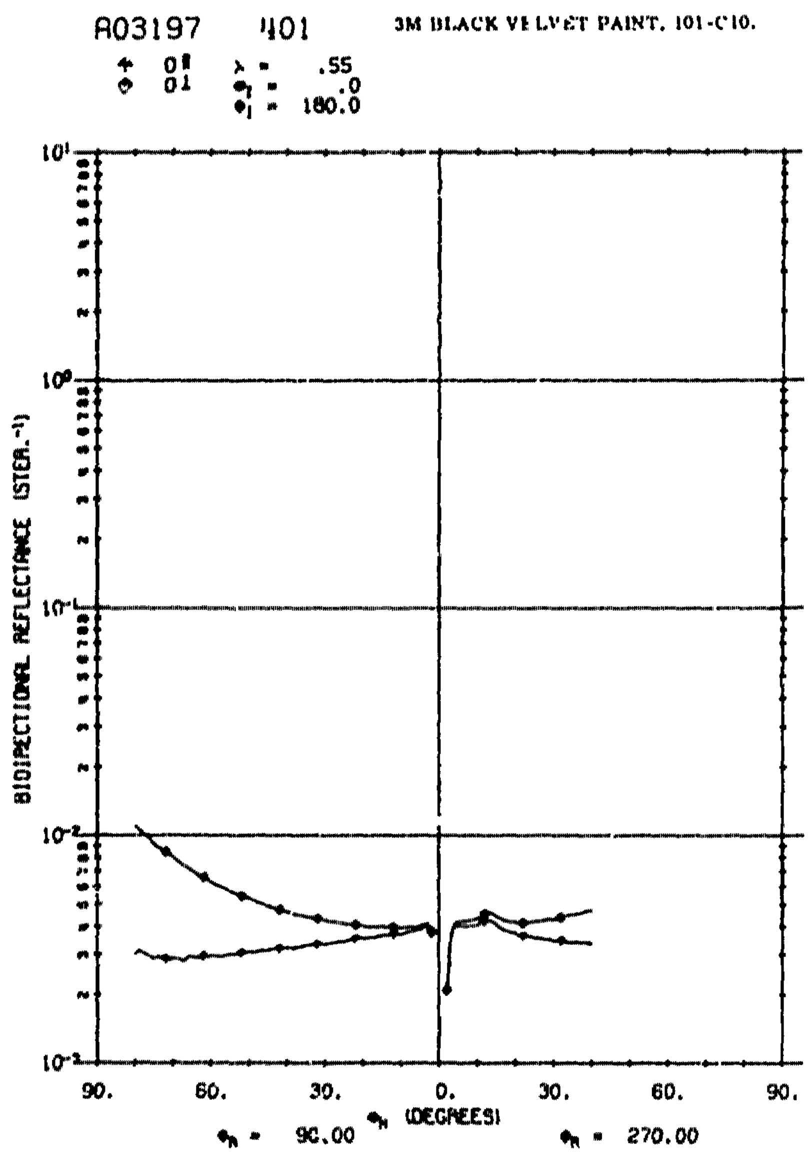

A03194 401
AEROJET SECOND SURFACE MIRROR
0∥
0⊥
λ = .55
θ_i = 40.0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00

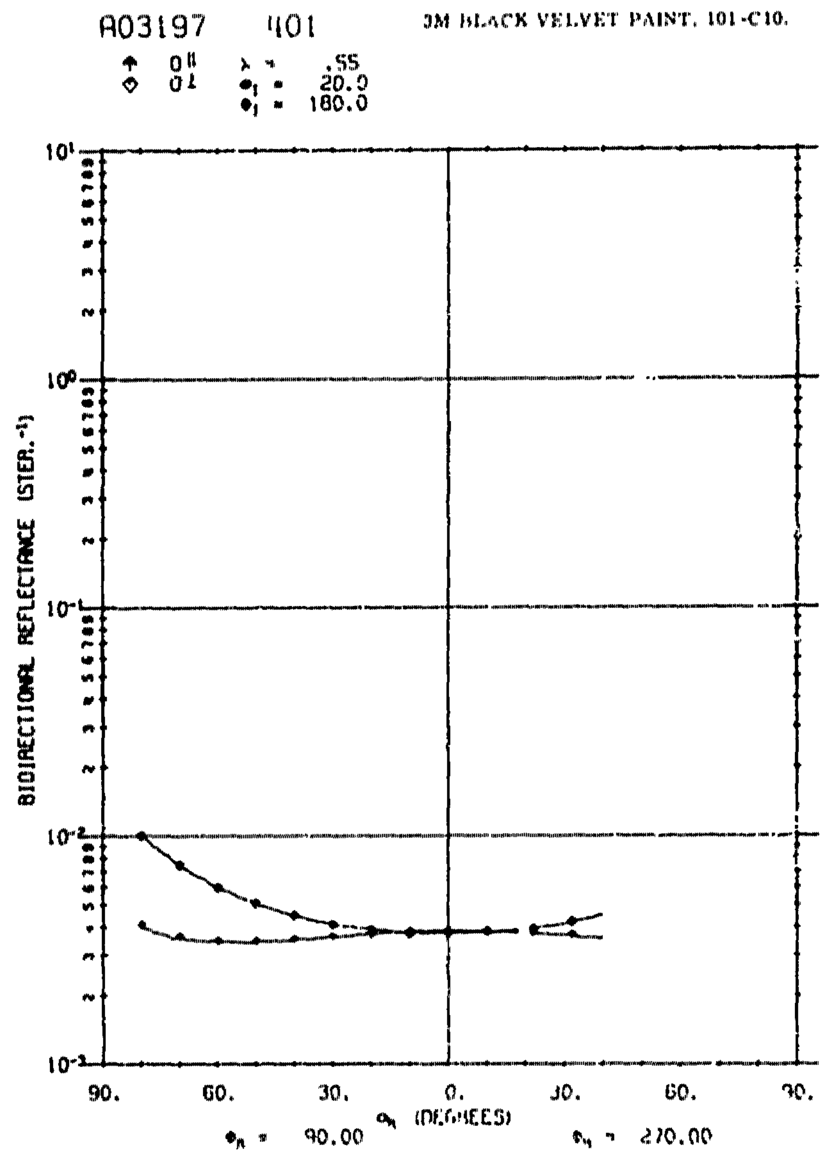

3M BLACK VELVET PAINT, 101-C10.
A03197 401
λ = .55
θi = 20.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θr (DEGREES)
φr = .00
φr = 180.00
90. 60. 30. 0. 30. 60. 90.

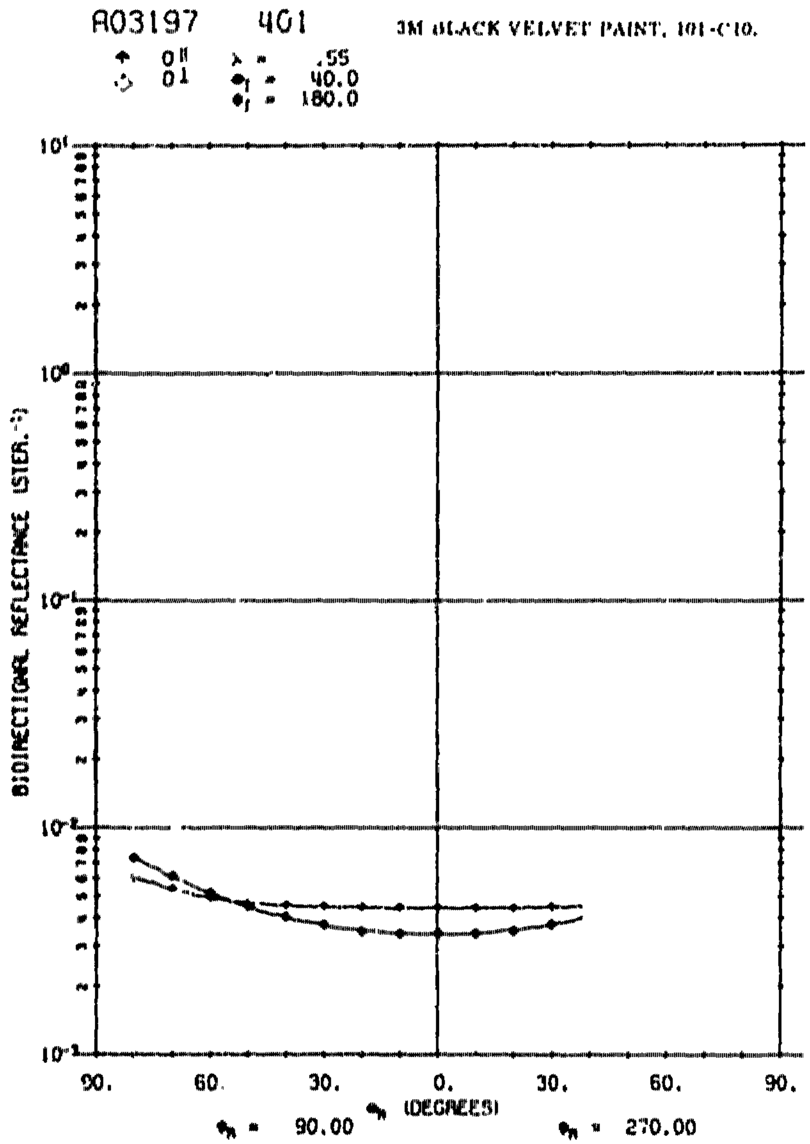

3M BLACK VELVET PAINT, 101-C10.
A03197 401
λ = .55
θi = .0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θr (DEGREES)
φr = .00
φr = 180.00
90. 60. 30. 0. 30. 60. 90.

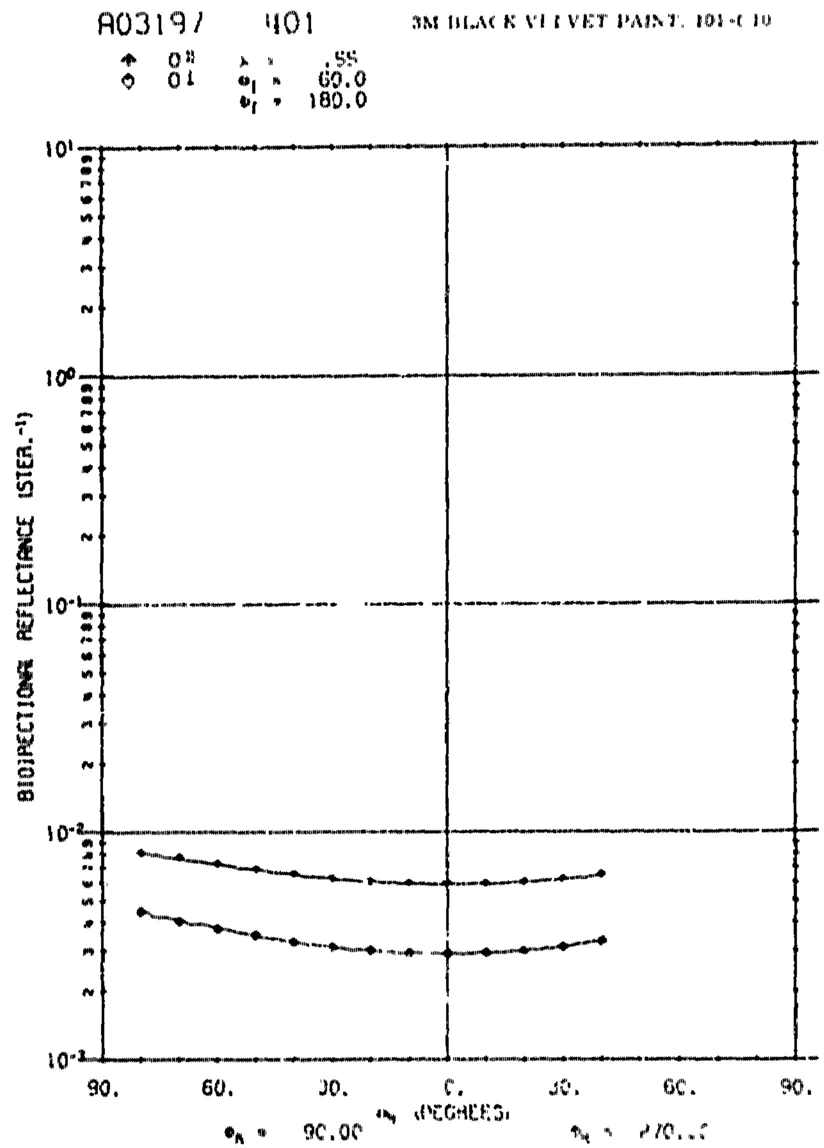

A03197 401
3M BLACK VELVET PAINT, 101-C10.
0∥ λ = .55
0⊥ θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00
φR = 180.00

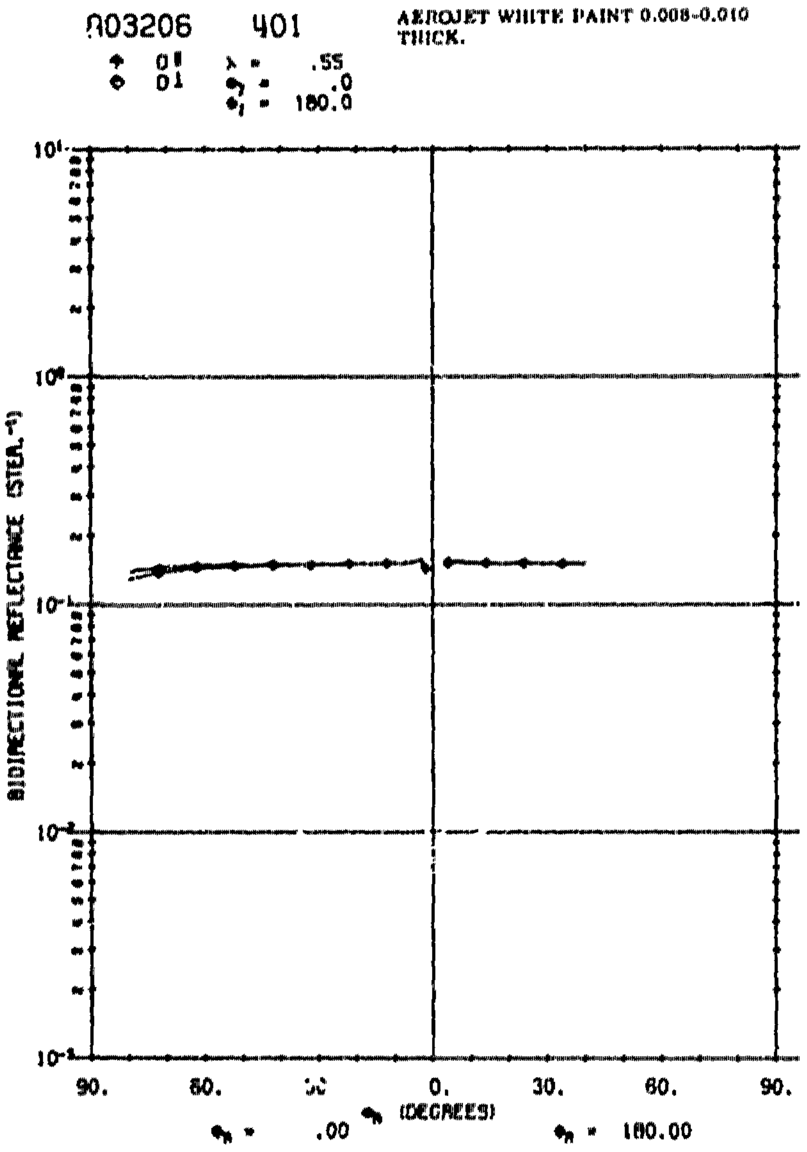

A03197 401
3M BLACK VELVET PAINT, 101-C10.
0∥ λ = .55
0⊥ θi = 60.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00
φR = 180.00

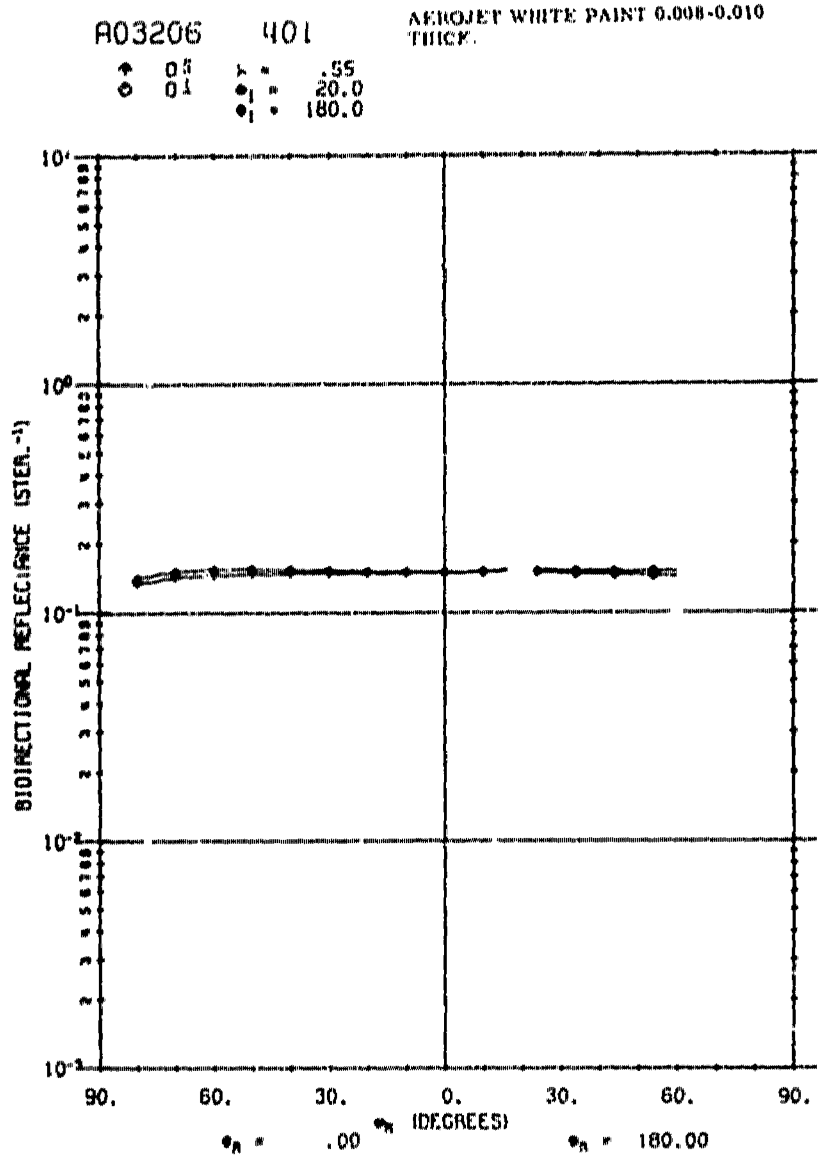

A03197 401
3M BLACK VELVET PAINT, 101-C10.
0∥
0⊥
λ = .55
θ_i = .0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00

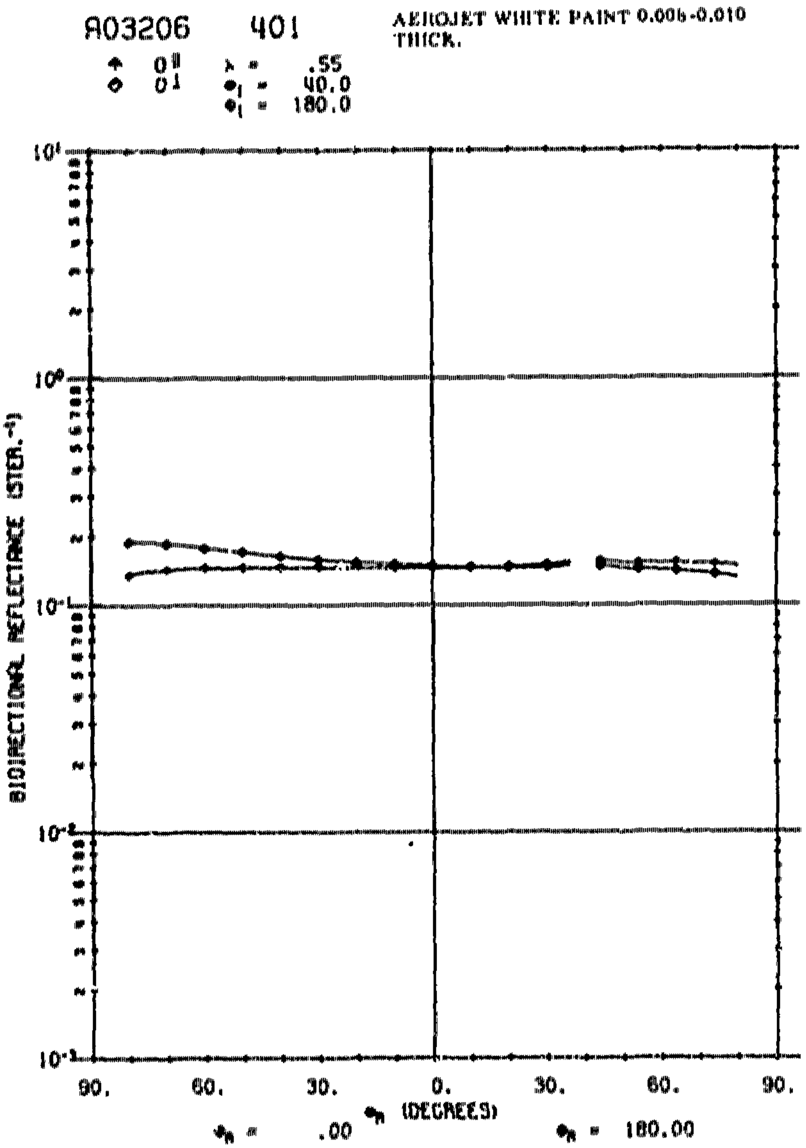

A03197 401
3M BLACK VELVET PAINT, 101-C10.
0∥
0⊥
λ = .55
θ_i = 20.0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00

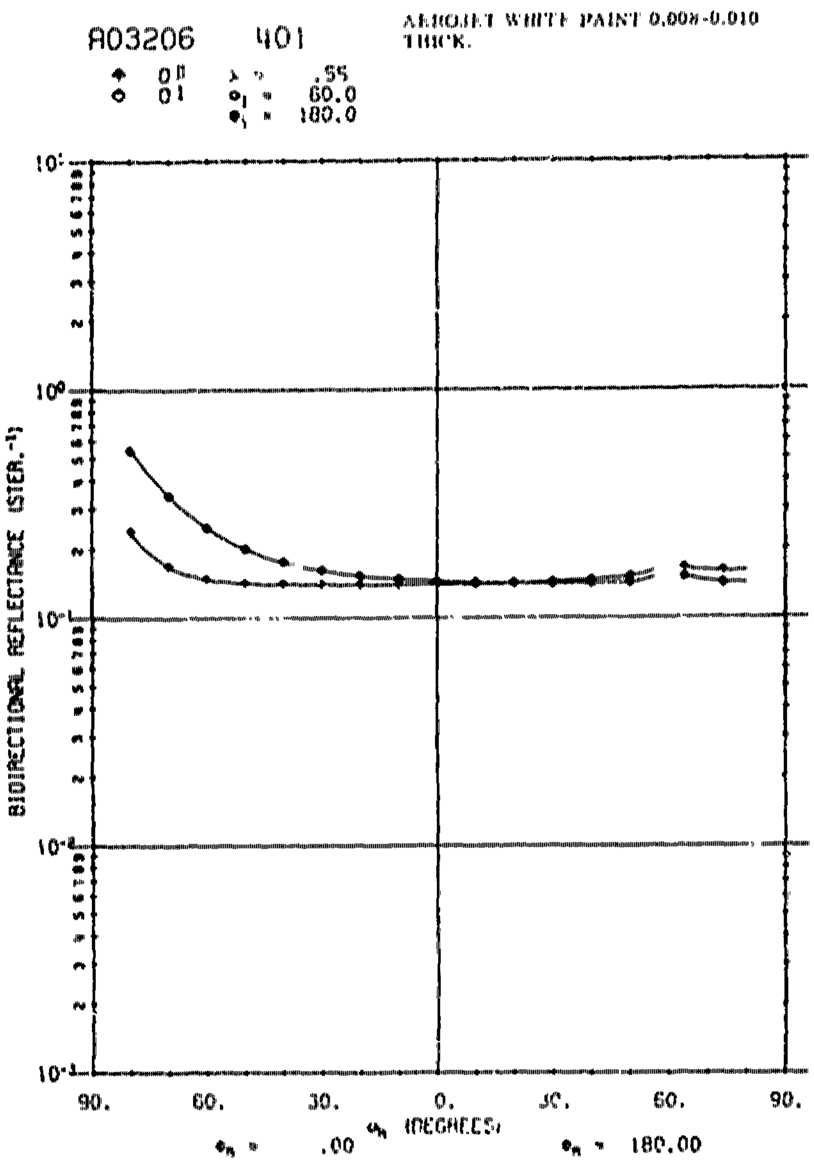

A03197 401
3M BLACK VELVET PAINT, 101-C10.
0‖
0⊥
λ = .55
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
φR = 90.00
φR = 270.00

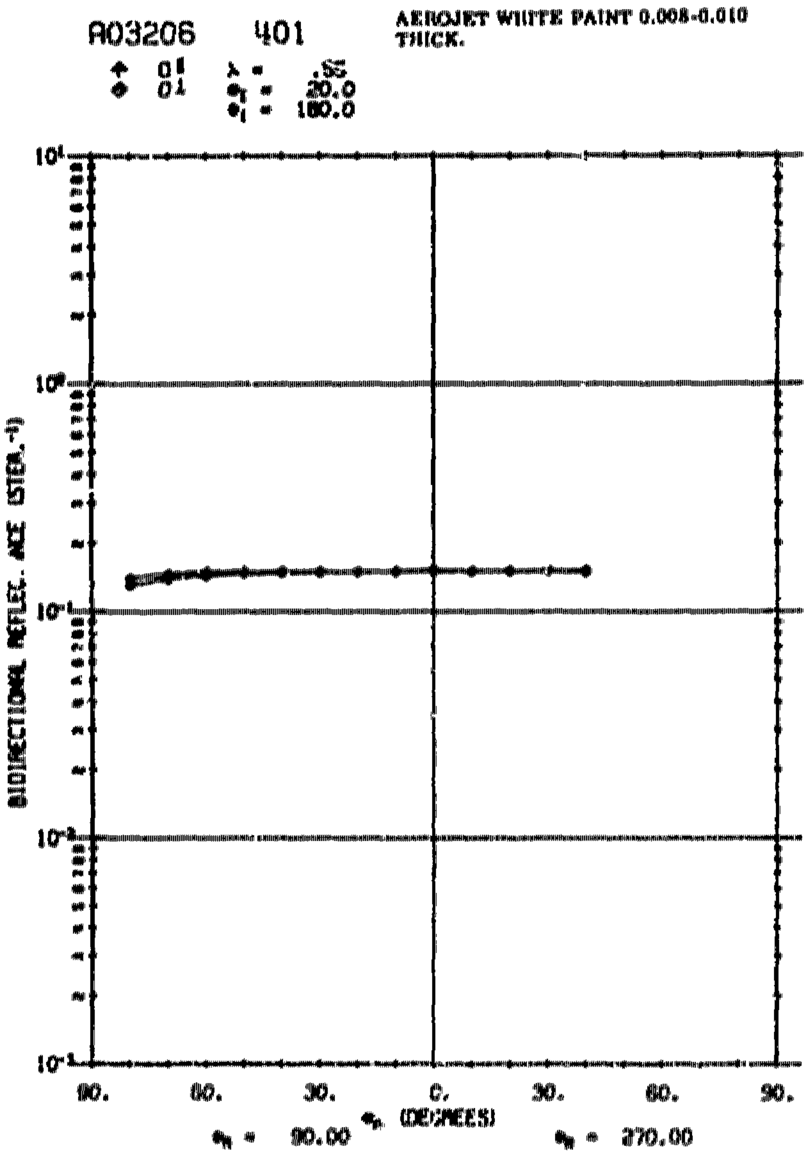

A03197 401
3M BLACK VELVET PAINT, 101-C10
0‖
0⊥
λ = .55
θi = 60.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
φR = 90.00

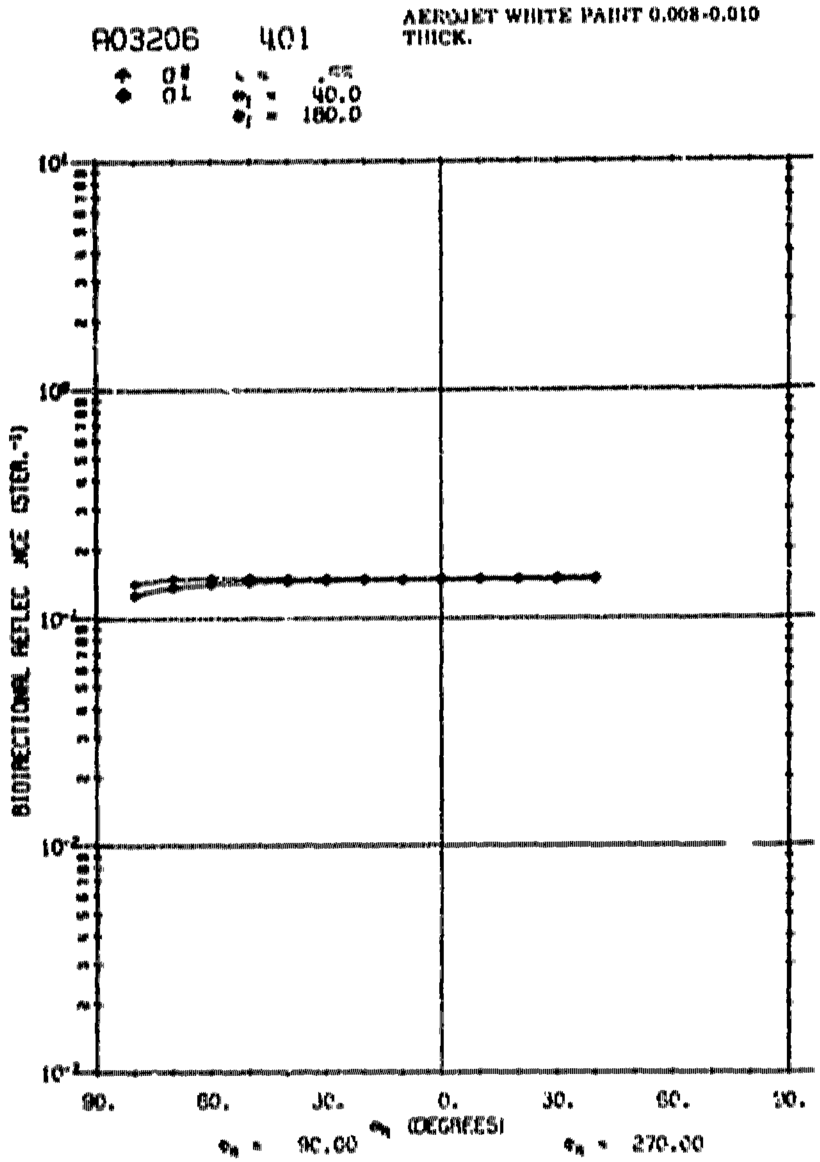

A03206 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .55
θ = .0
φ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
φ = .00
(DEGREES)
φ = 180.00

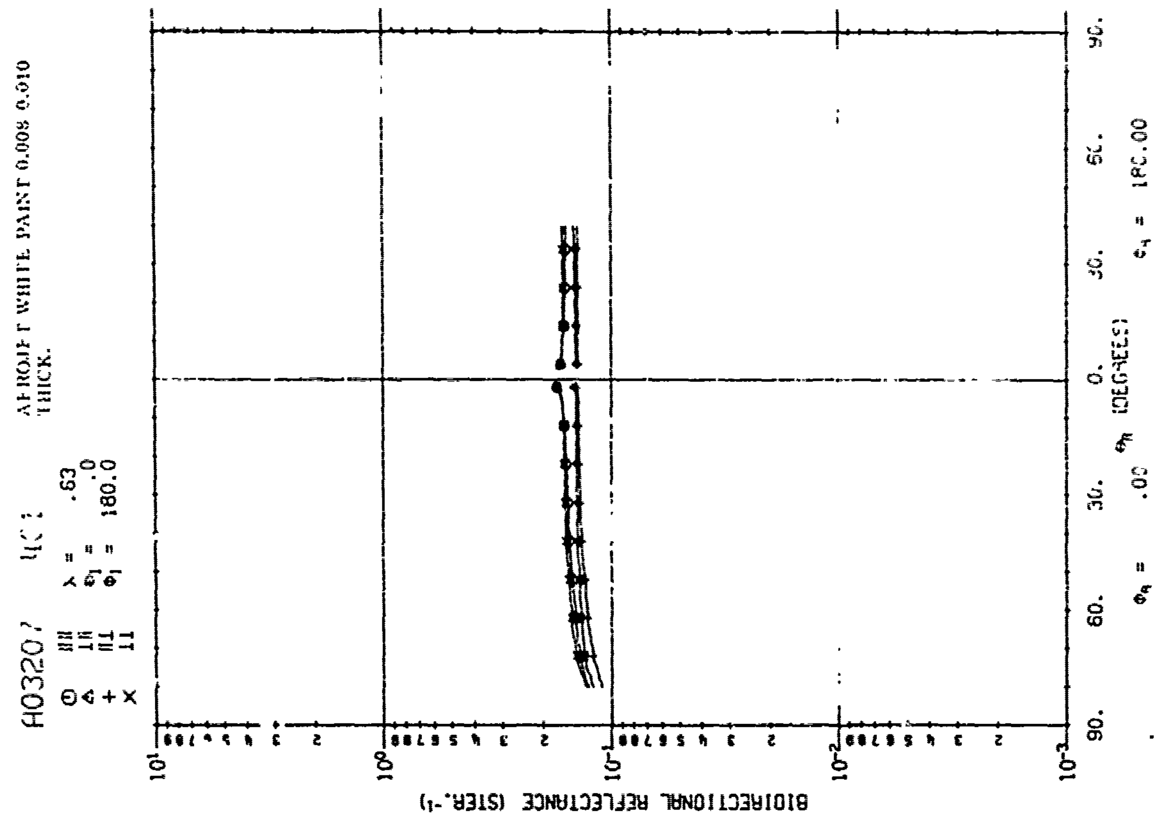

A03206 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .55
θ = 20.0
φ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
φ = .00
(DEGREES)
φ = 180.00

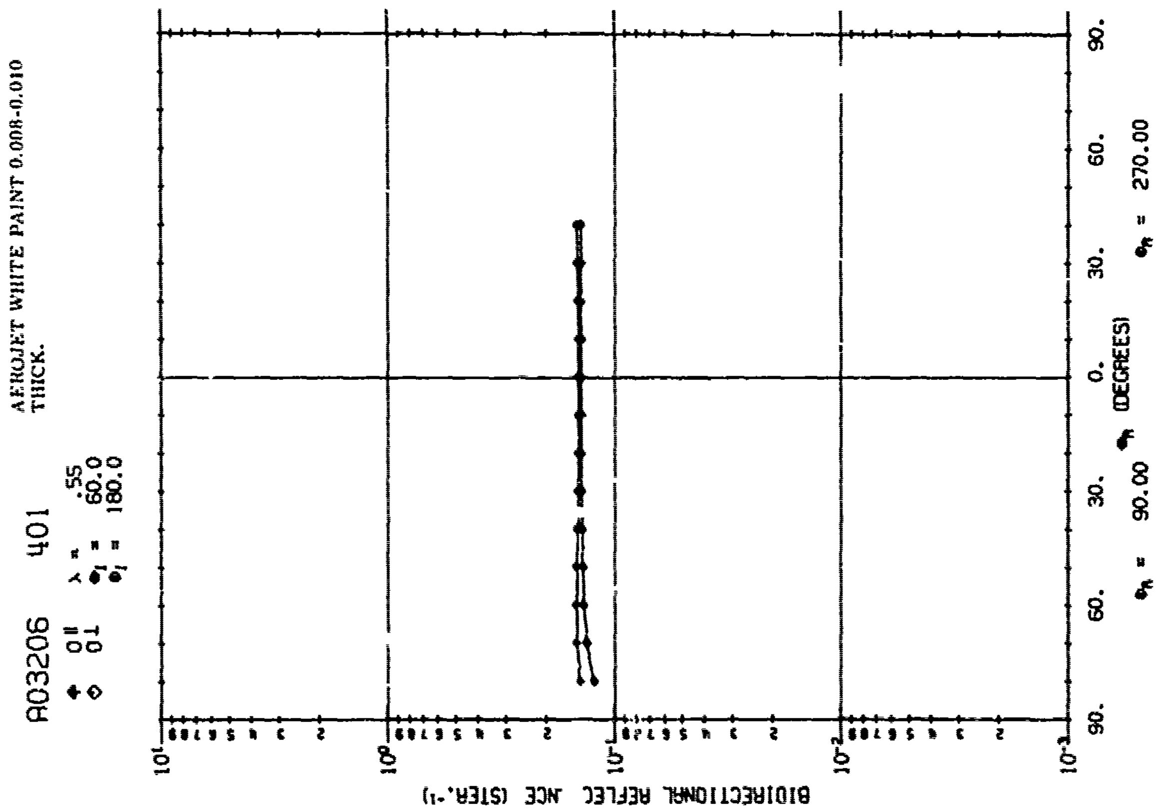

A03206 401
AEROJET WHITE PAINT 0.006-0.010 THICK.
0∥
0⊥
λ = .55
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
10¹
10⁰
10⁻¹
10⁻²
10⁻³
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = .00
φR = 180.00

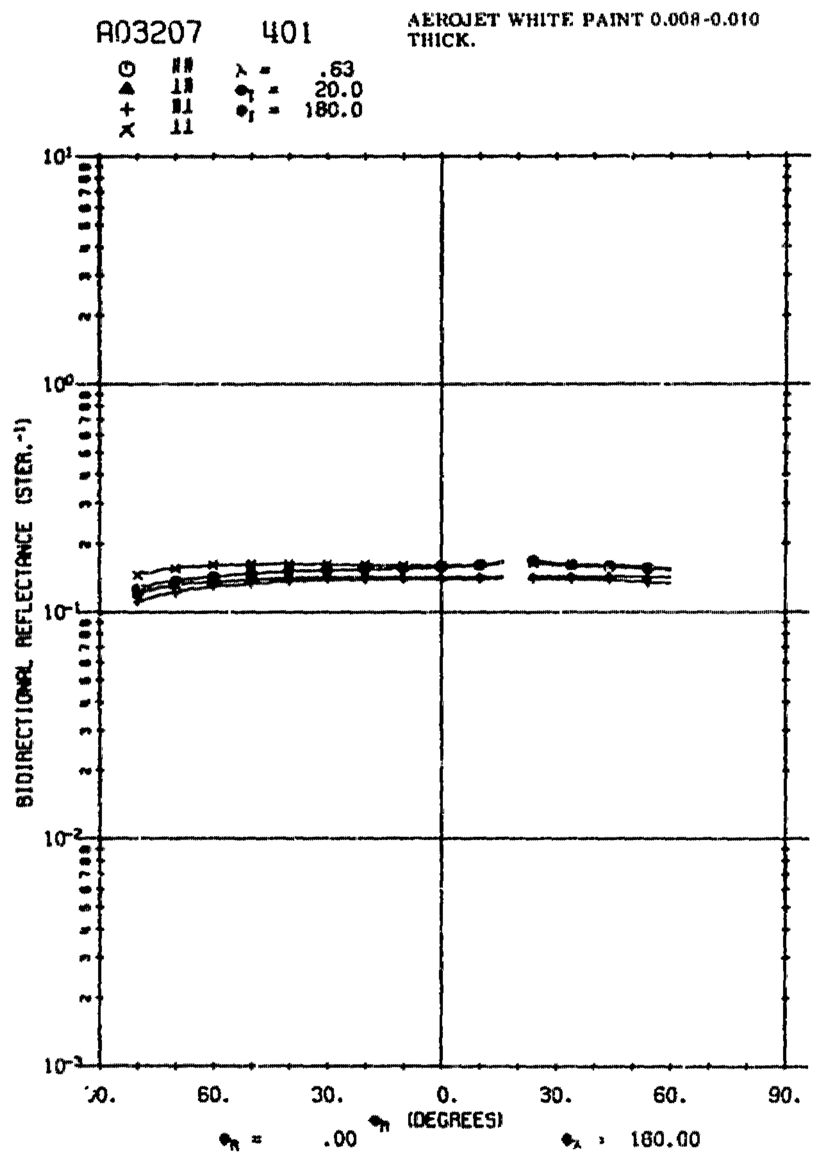

A03206 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
0∥
0⊥
λ = .55
θi = 60.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
10¹
10⁰
10⁻¹
10⁻²
10⁻³
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = .00
φR = 180.00

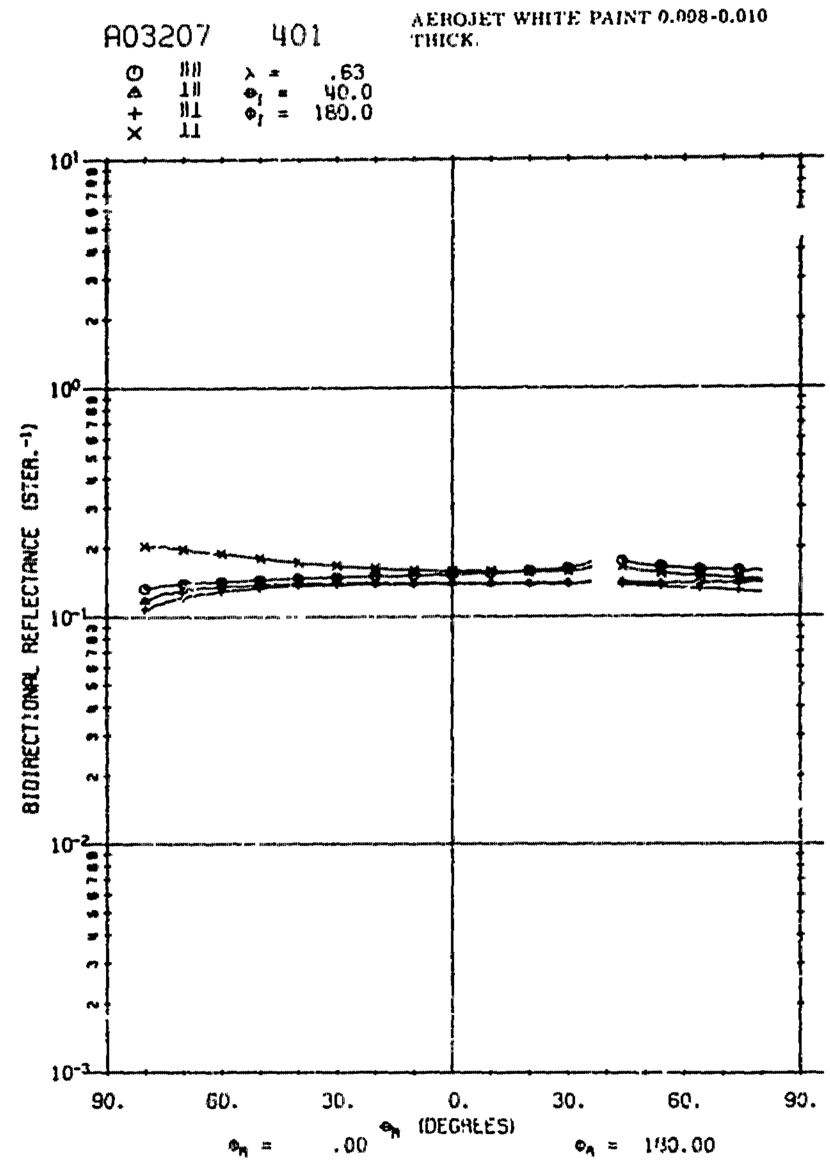

A03206 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .55
θ = 20.0
φ = 180.0
BIDIRECTIONAL REFLEC. ANCE (STER.-1)
φ (DEGREES)
φ = 90.00
φ = 270.00

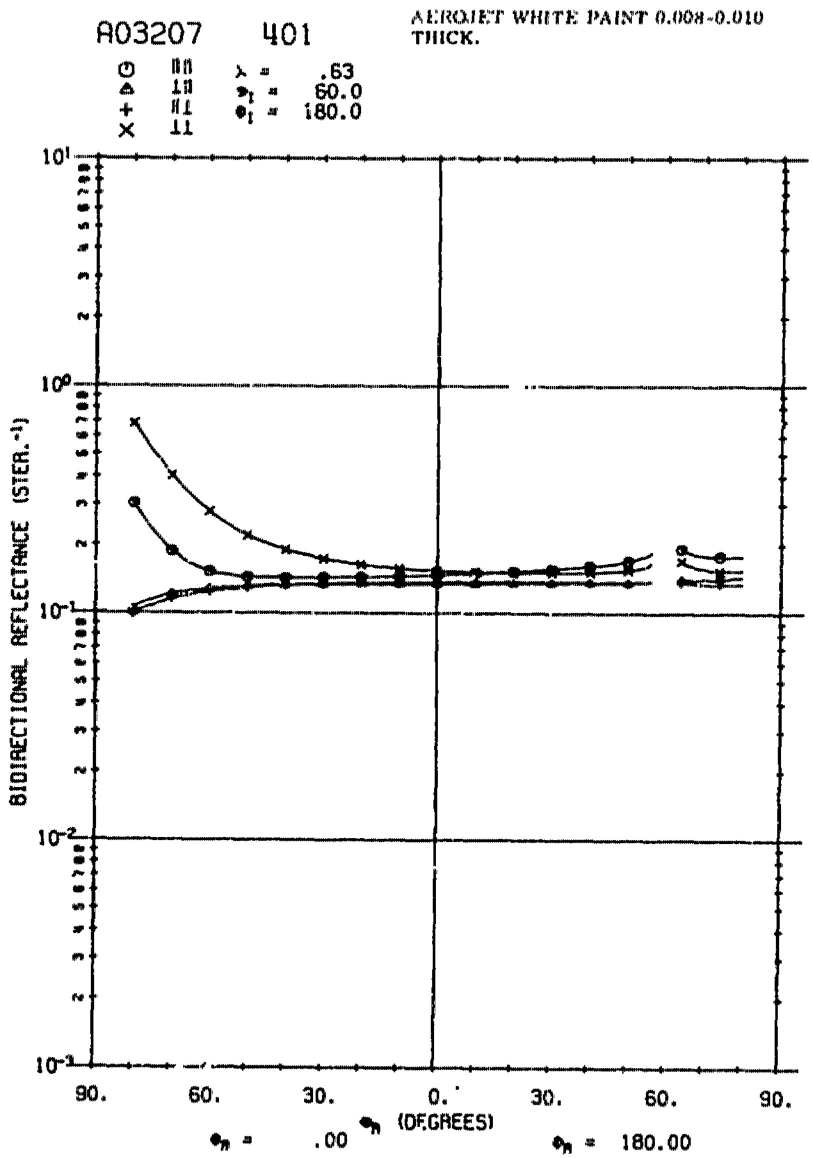

A03206 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
θ = 40.0
φ = 180.0
BIDIRECTIONAL REFLEC. ANCE (STER.-1)
φ (DEGREES)
φ = 90.00
φ = 270.00

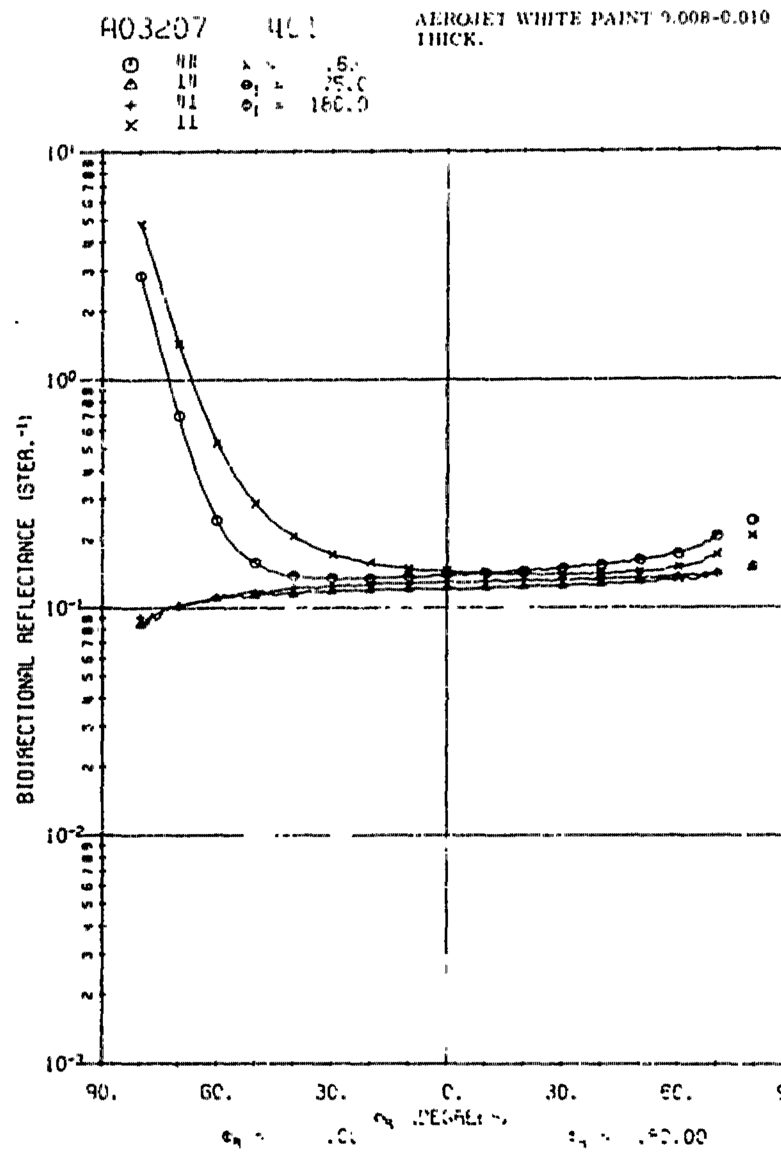

AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .63
180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
(DEGREES)
φR = 180.00

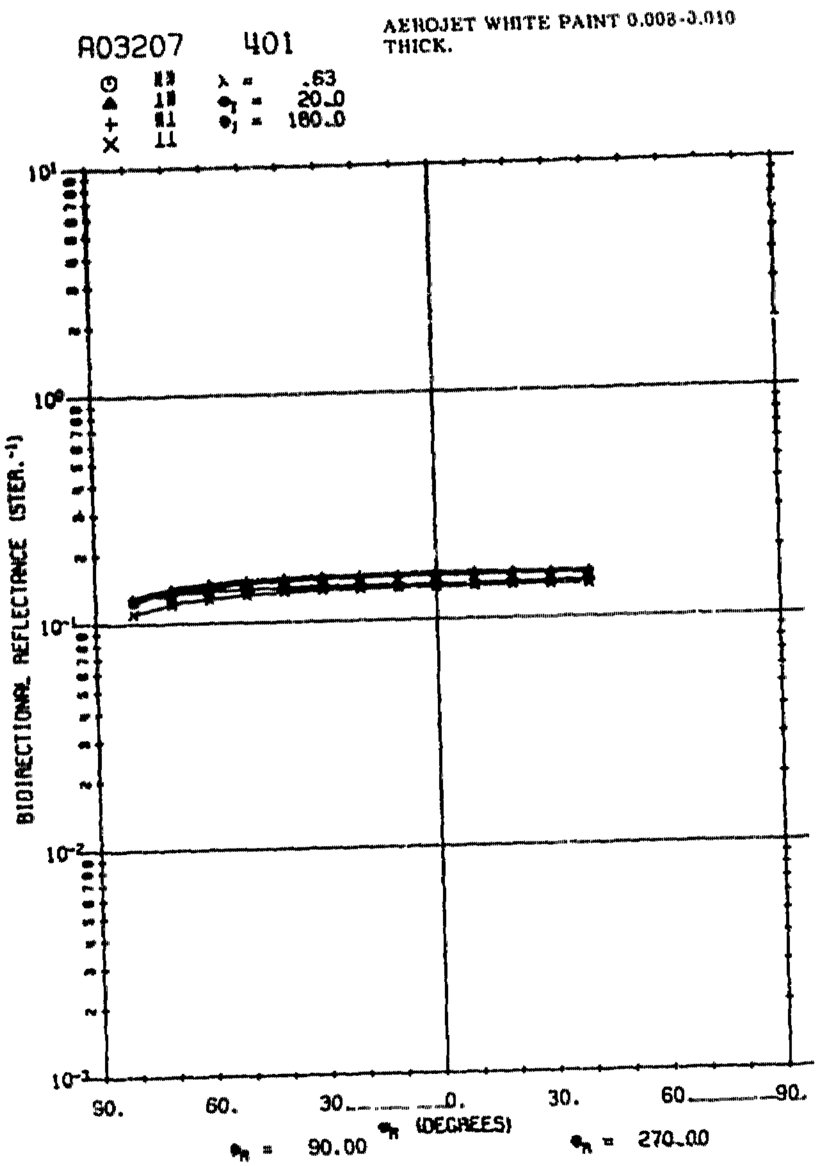

A03206 401
λ = .55
60.0
180.0
AEROJET WHITE PAINT 0.008-0.010 THICK.
BIDIRECTIONAL REFLEC NCE (STER.-1)
(DEGREES)
φR = 90.00
φR = 270.00

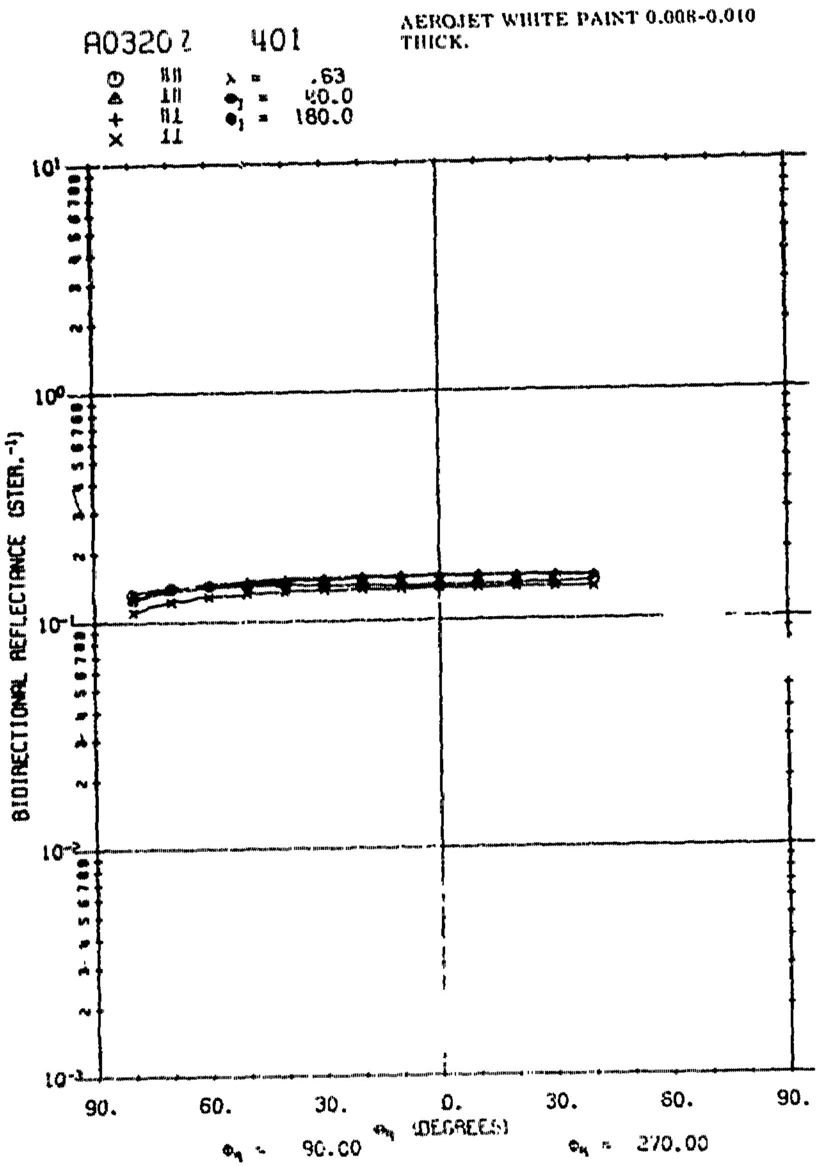

A03207 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .63
Φ = 20.0
Φ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
.00
180.00

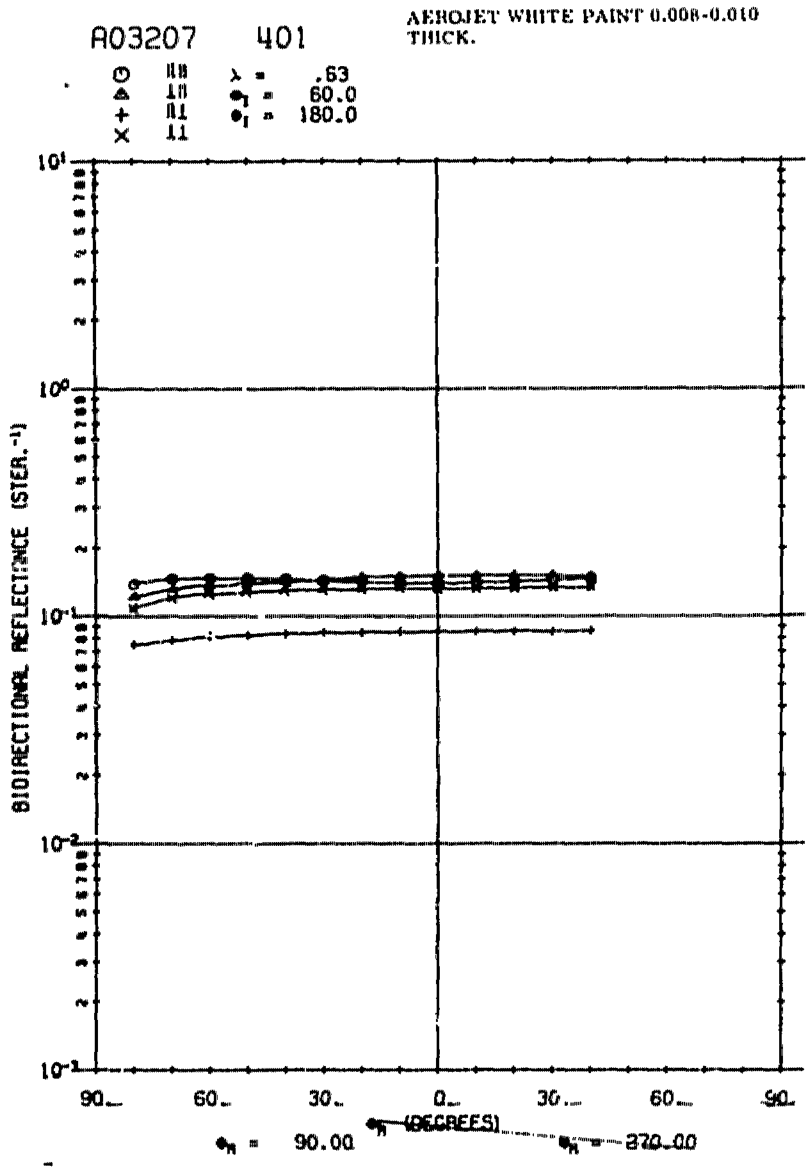

A03207 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .63
Φ = 40.0
Φ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
(DEGREES)
.00
180.00

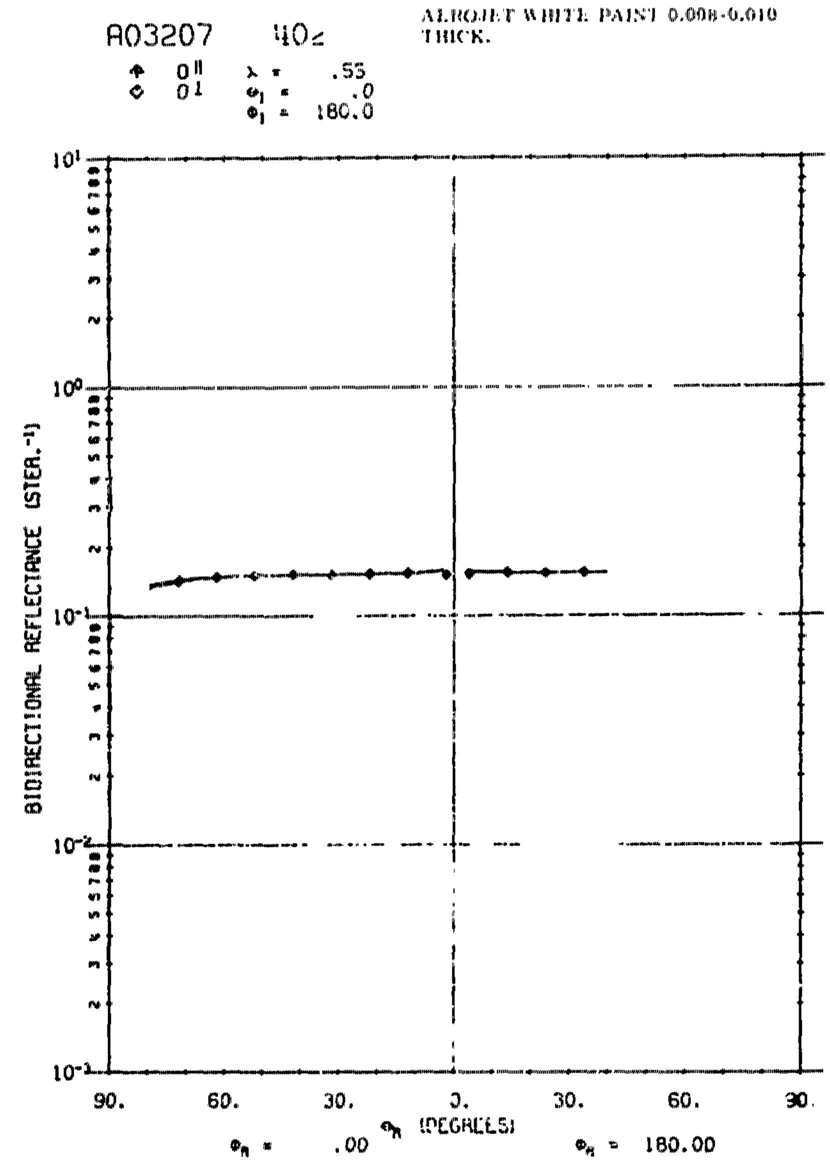

A03207 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .63
θ_I = 60.0
Φ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θ_R (DEGREES)
Φ_R = .00
Φ_R = 180.00

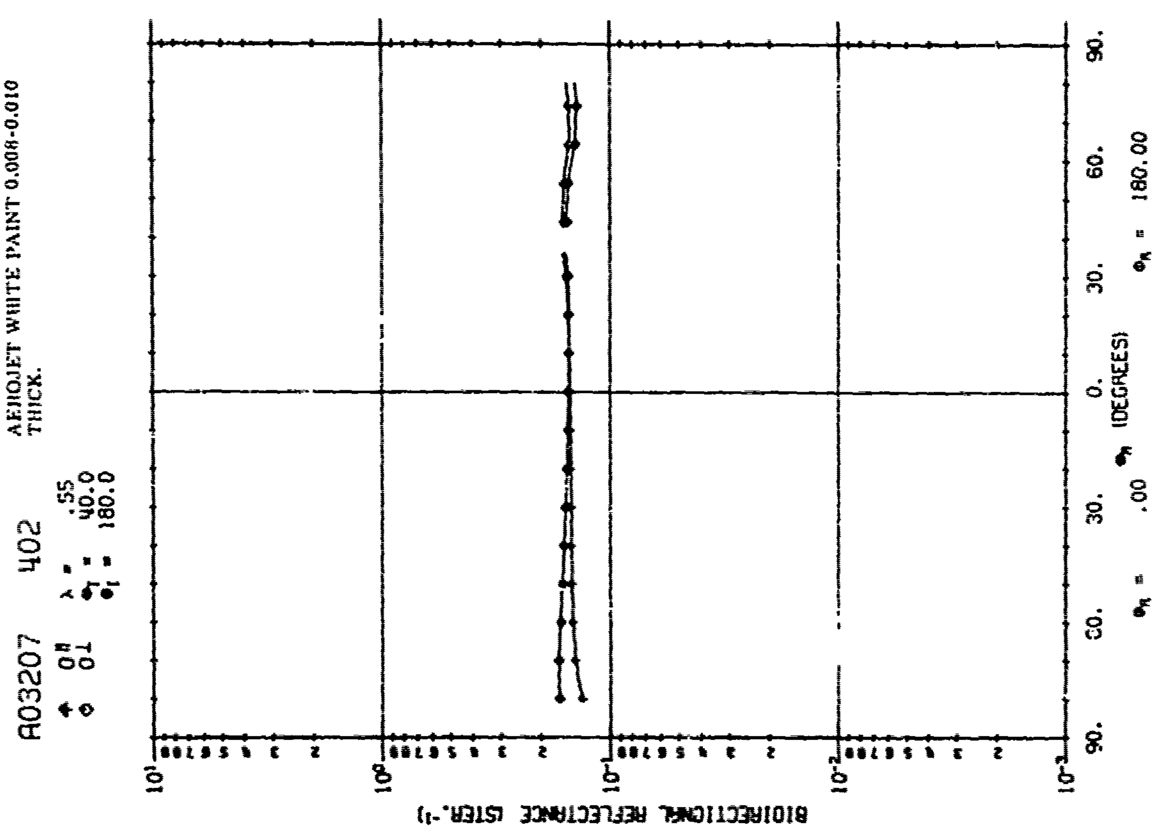

A03207
AEROJET WHITE PAINT 0.008-0.010 THICK.
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)

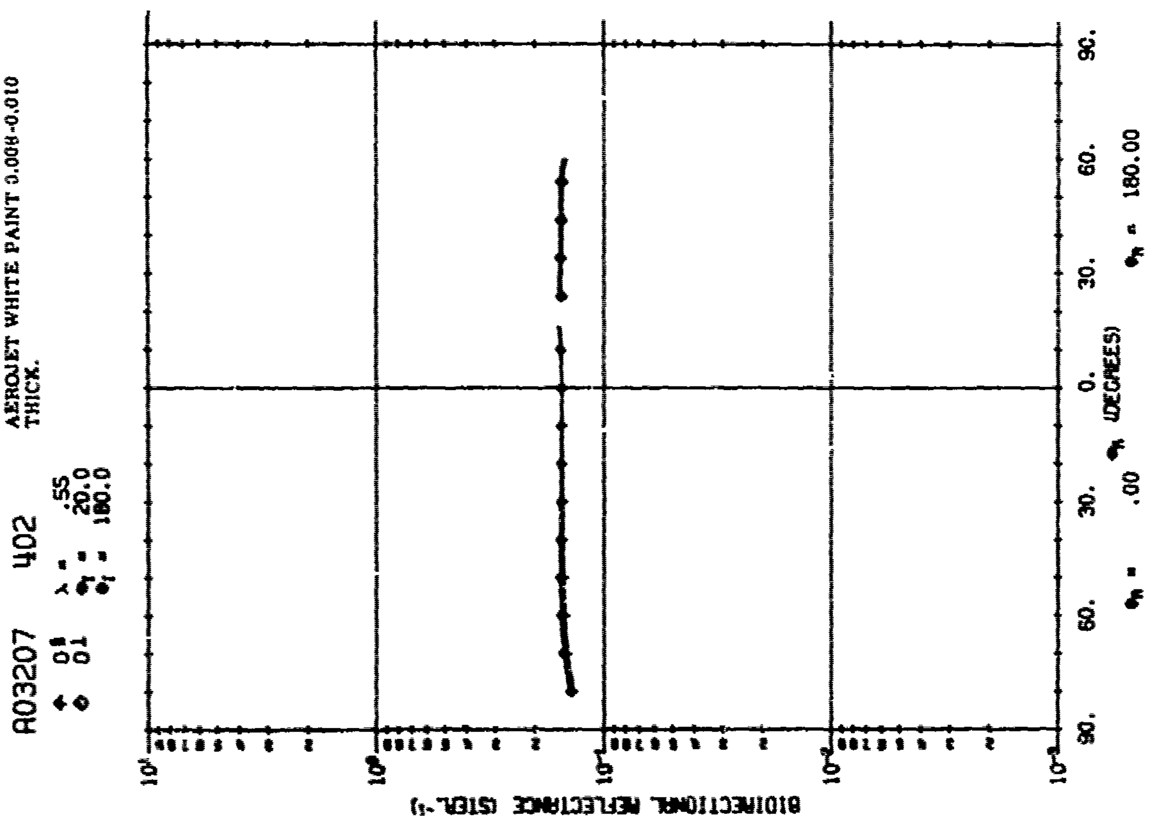

A03207 401
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = .63
θ = 20.0
φ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
90. 60. 30. 0. 30. 60. 90.
(DEGREES)
φ = 90.00
φ = 270.00

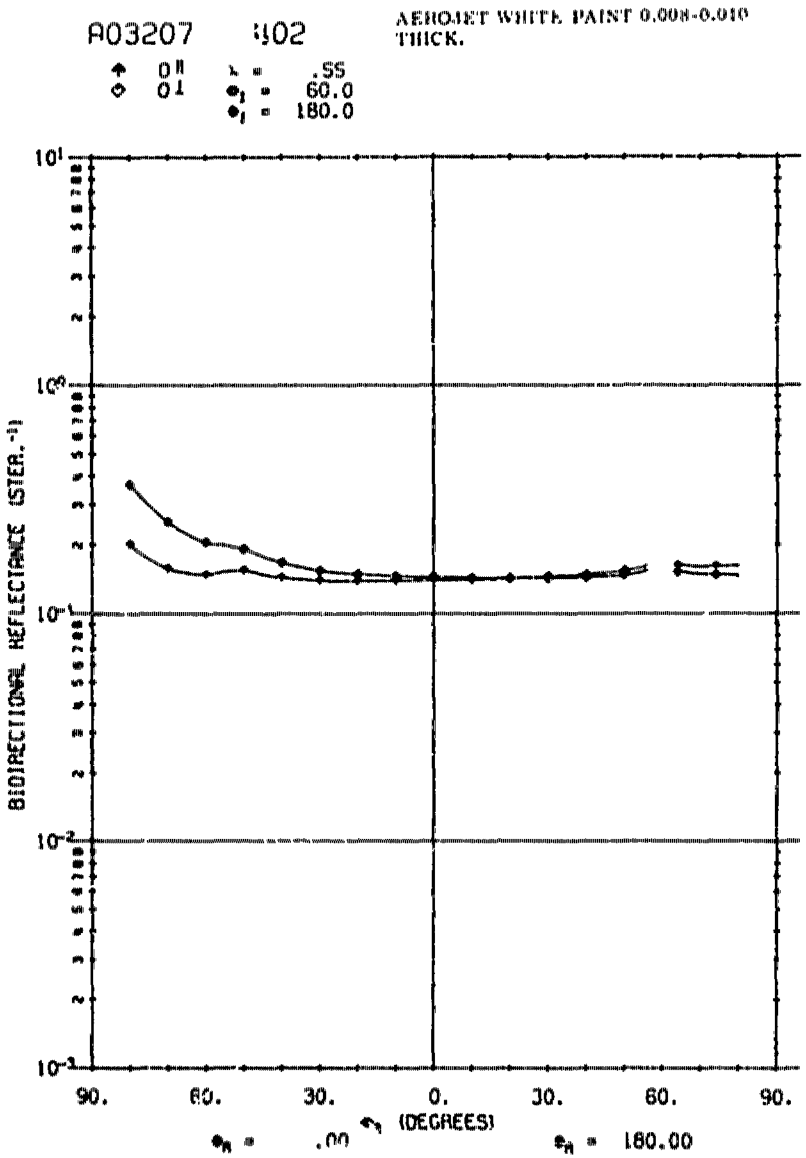

AEROJET WHITE PAINT 0.008-0.010 THICK.
401
λ = .63
θ = 40.0
φ = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
90. 60. 30. 0. 30. 60. 90.
(DEGREES)
φ = 90.00
φ = 270.00

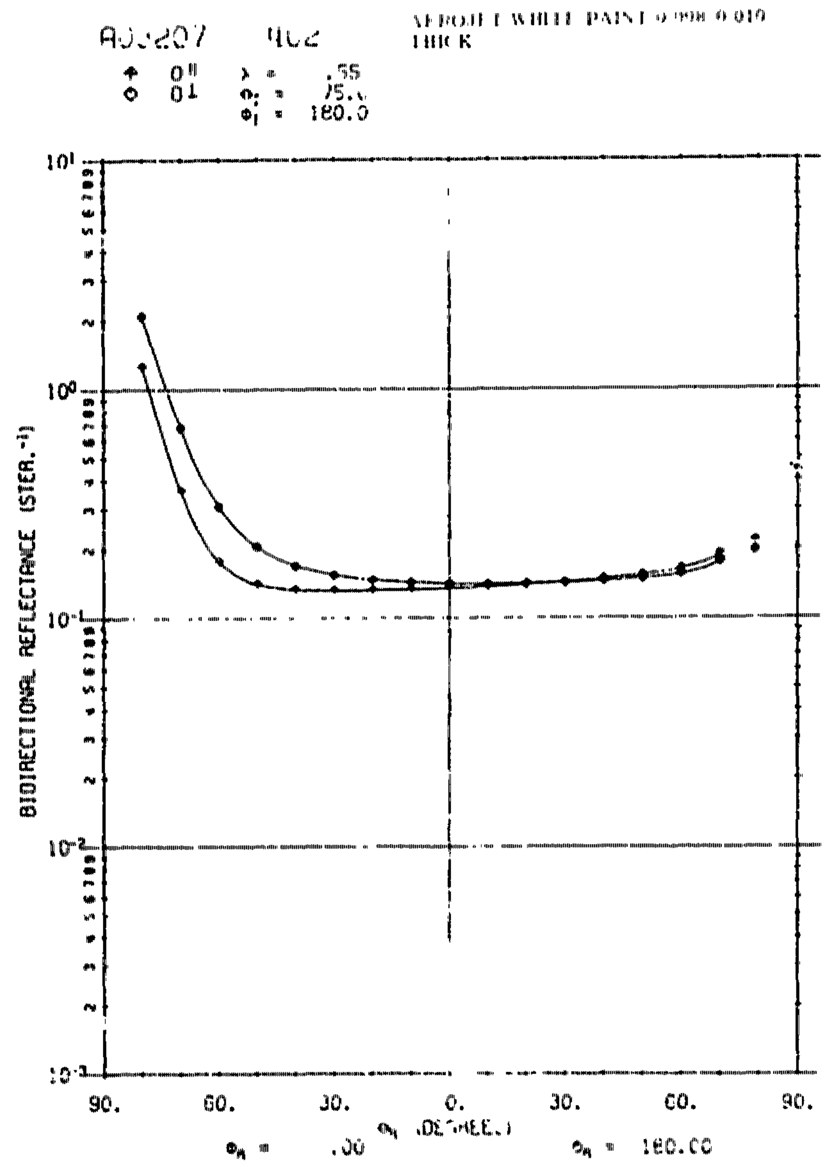

AEROJET WHITE PAINT 0.008-0.010 THICK.
A03207 401
λ = .63
θi = 60.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = 90.00
φR = 270.00

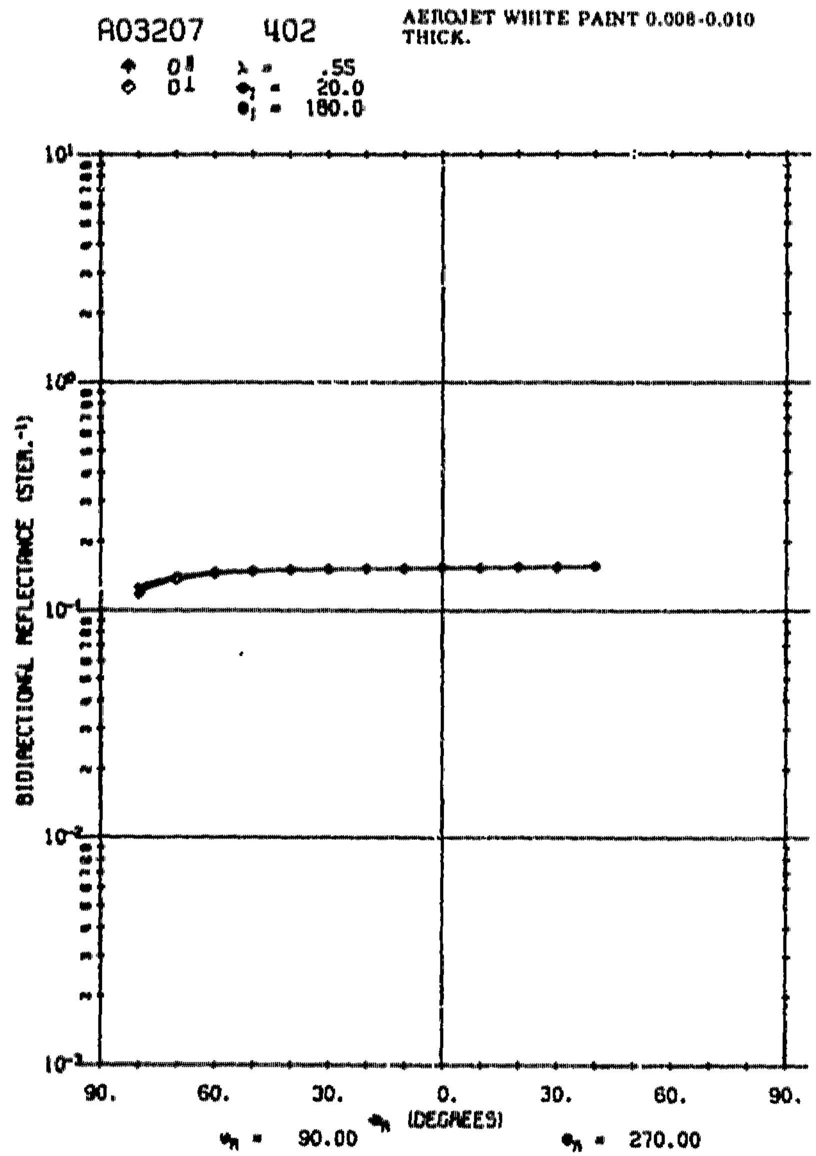

AEROJET WHITE PAINT 0.008-0.010 THICK.
A03207 402
λ = .55
θi = .0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = .00
φR = 180.00

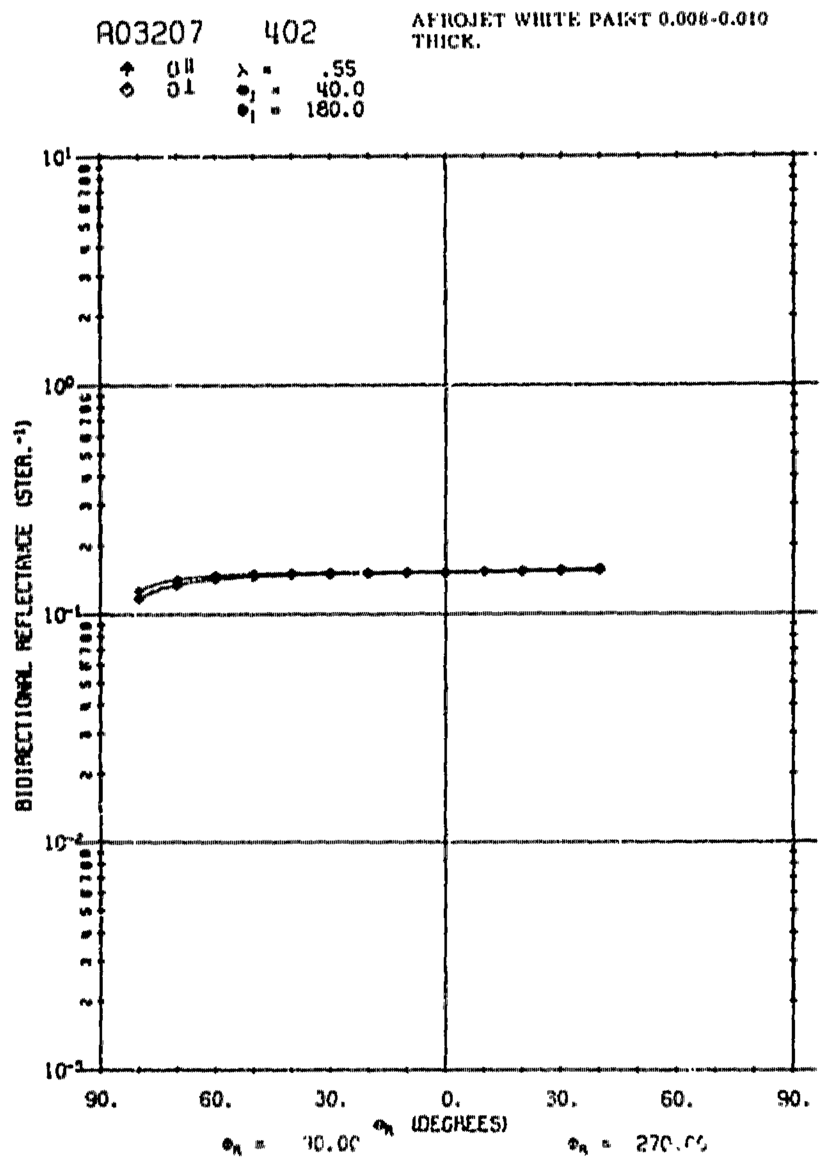

A03207 402
0R λ = .55
0I θi = 40.0
φi = 180.0
AEROJET WHITE PAINT 0.008-0.010 THICK.
BIDIRECTIONAL REFLECTANCE (STER.-1)
φR = .00
θR (DEGREES)
φR = 180.00

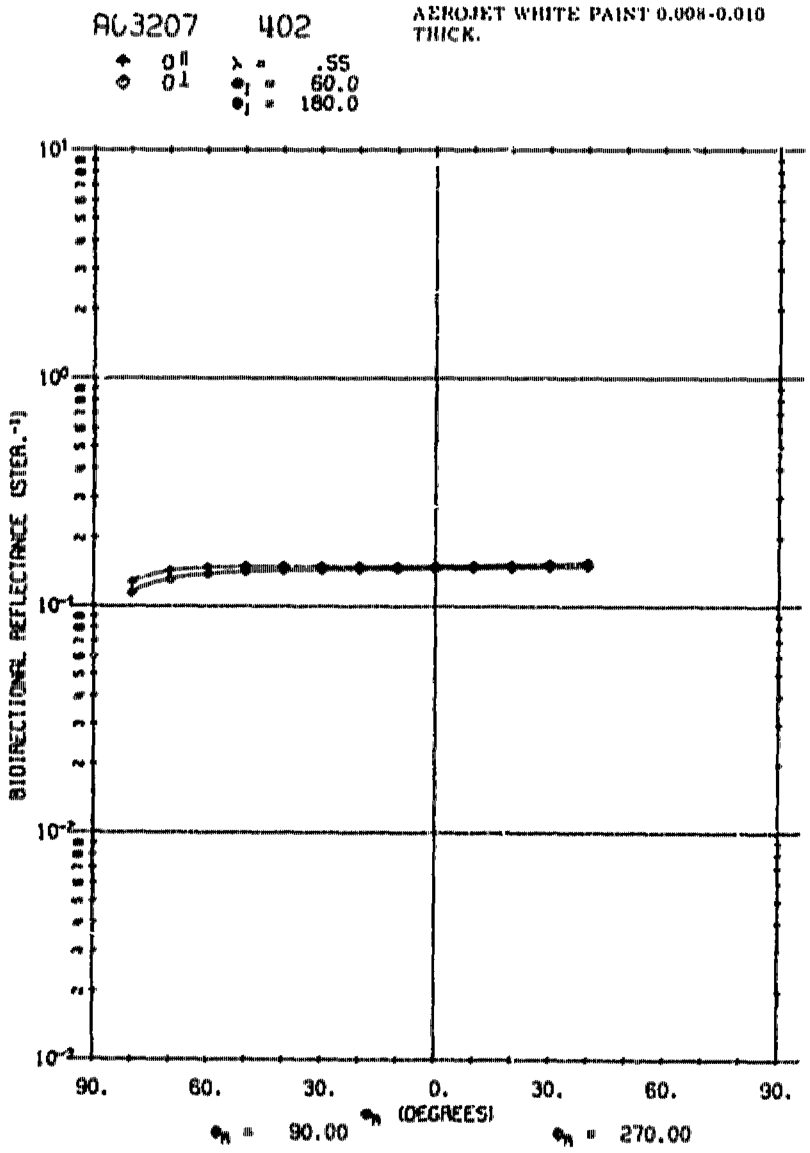

A03207 402
0R λ = .55
0I θi = 20.0
φi = 180.0
AEROJET WHITE PAINT 0.008-0.010 THICK.
BIDIRECTIONAL REFLECTANCE (STER.-1)
φR = .00
θR (DEGREES)
φR = 180.00


A03207 402
AEROJET WHITE PAINT 0.008-0.010 THICK.
◆ 0∥ ◇ 01
λ = .55
θi = 60.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
φR = .00 θR (DEGREES) φR = 180.00

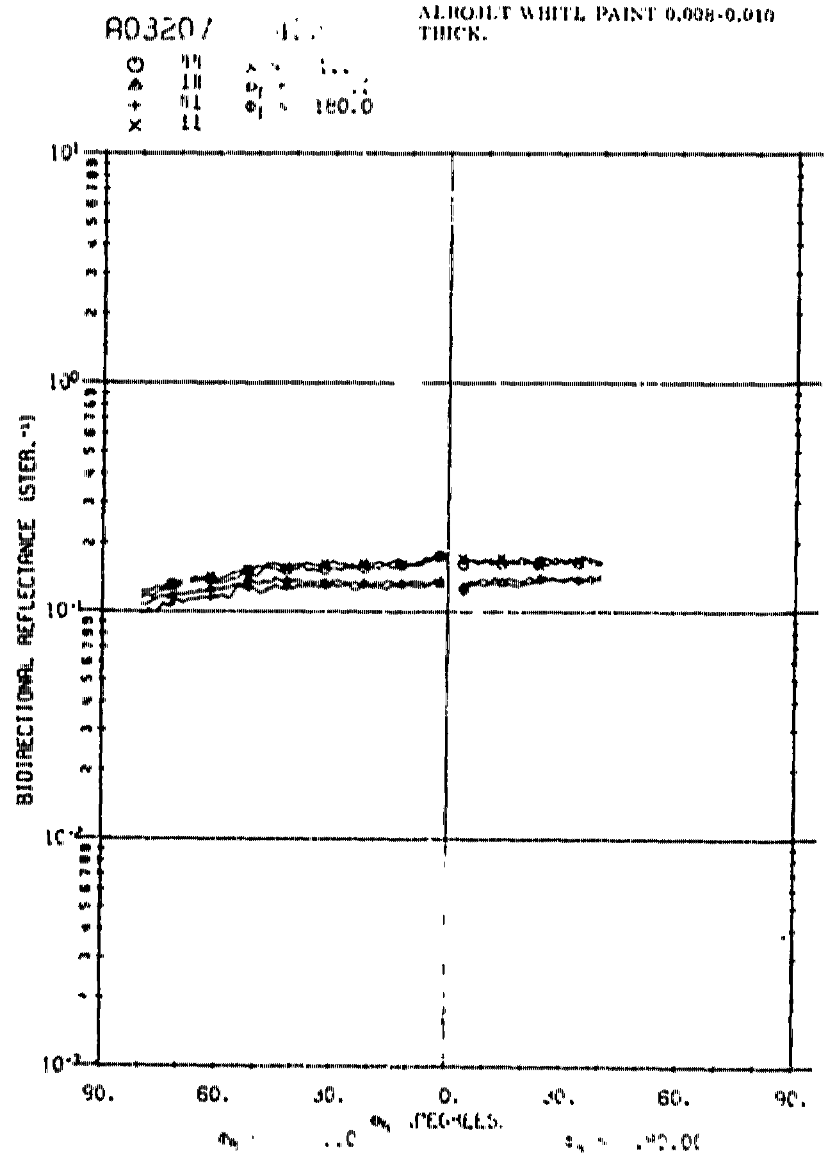

402
λ = .55
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.


A03207 402
AEROJET WHITE PAINT 0.008-0.010 THICK.
0∥
0⊥
λ = .55
θi = 20.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)
φR = 90.00
φR = 270.00

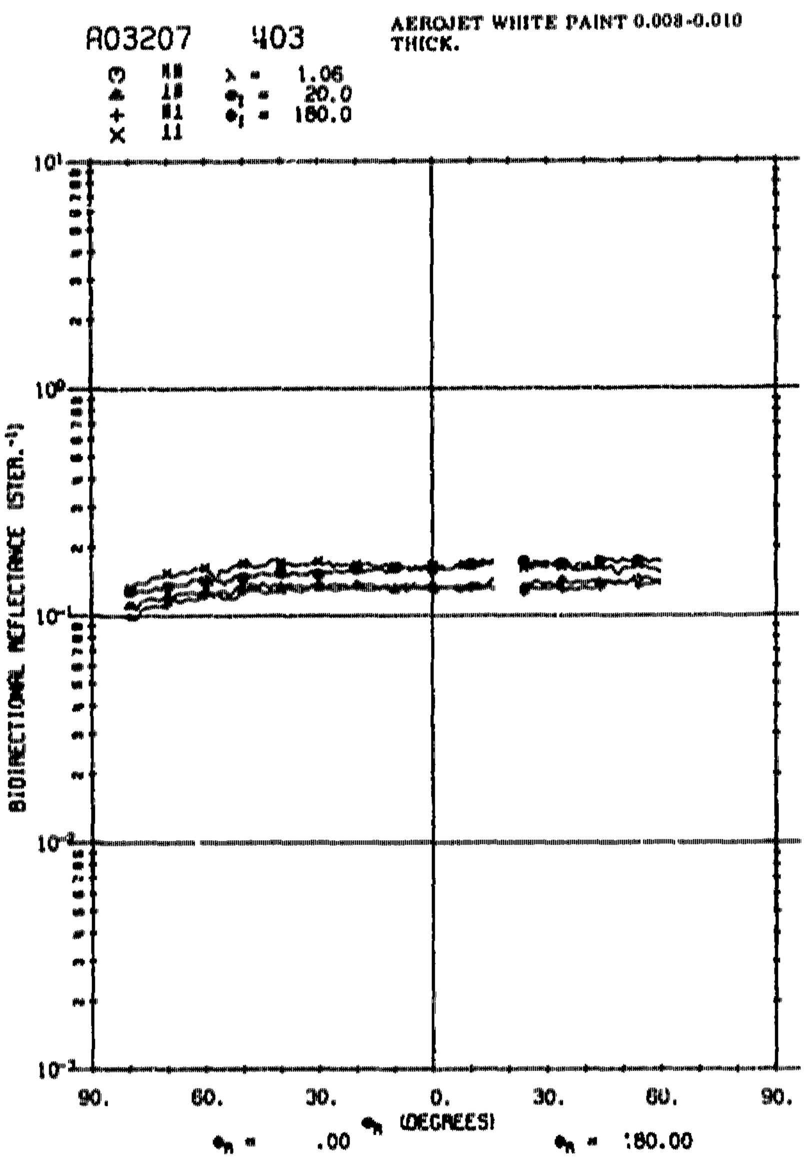

A03207 402
AEROJET WHITE PAINT 0.008-0.010 THICK.
0∥
0⊥
λ = .55
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
θR (DEGREES)

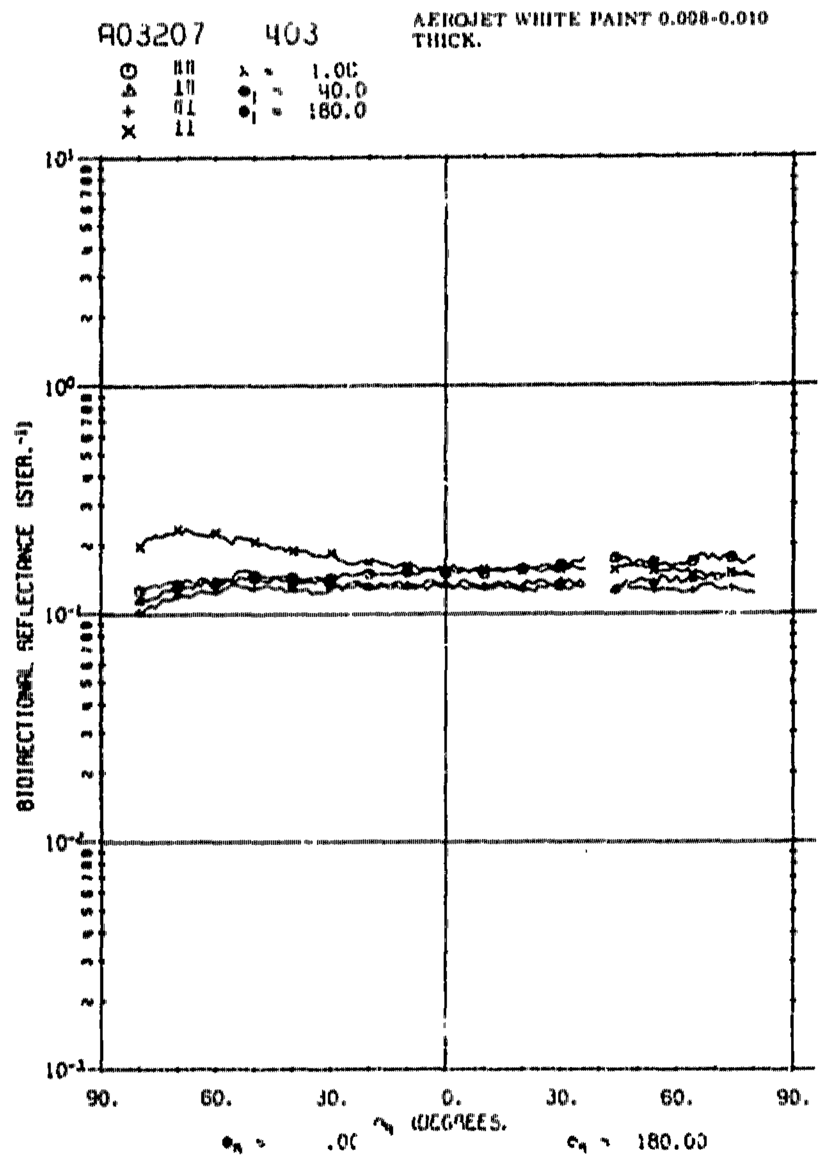


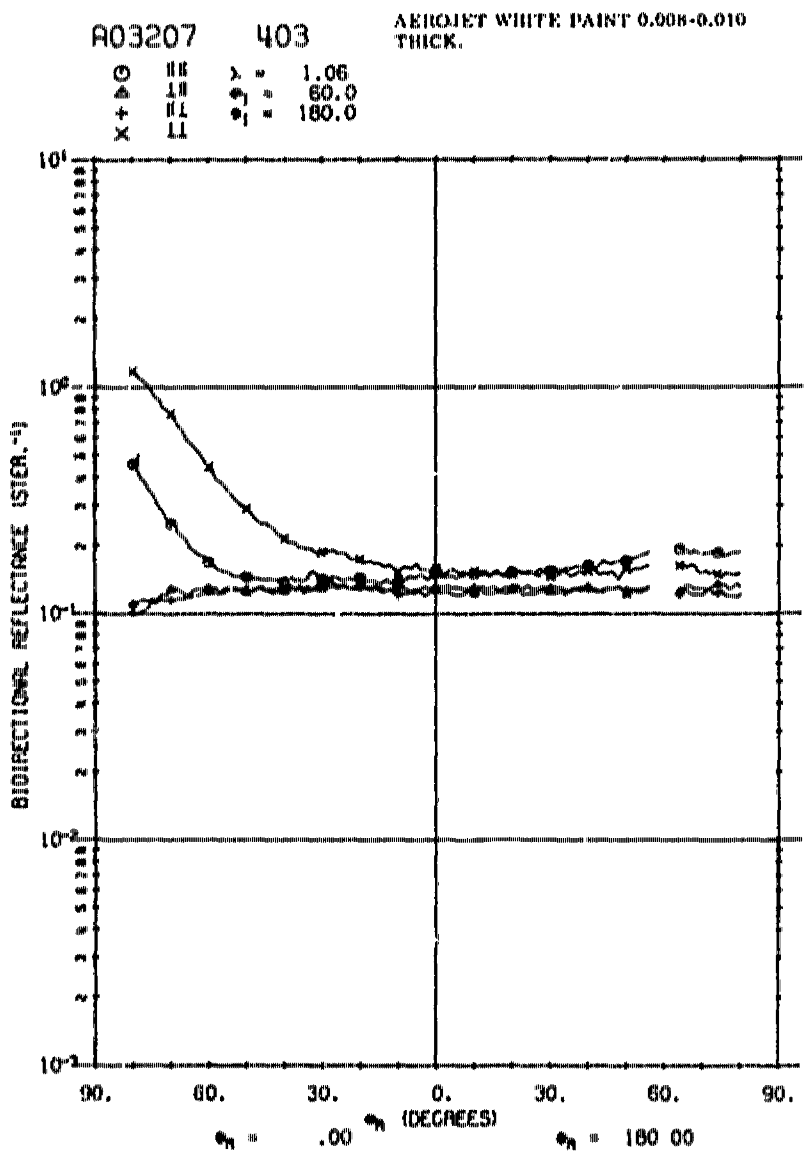
AC3207 402
AEROJET WHITE PAINT 0.008-0.010 THICK.
0∥
0⊥
λ = .55
θ_i = 60.0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
θ_R (DEGREES)
ϕ_R = 90.00
ϕ_R = 270.00

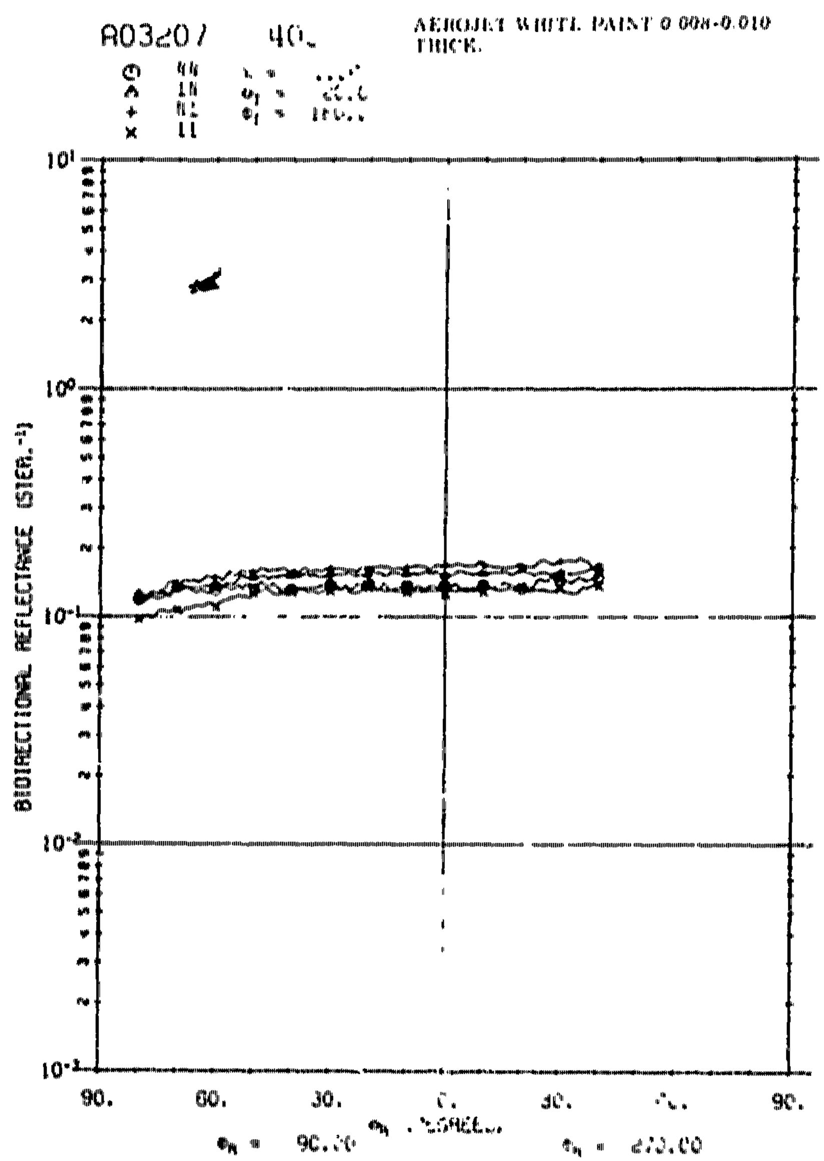


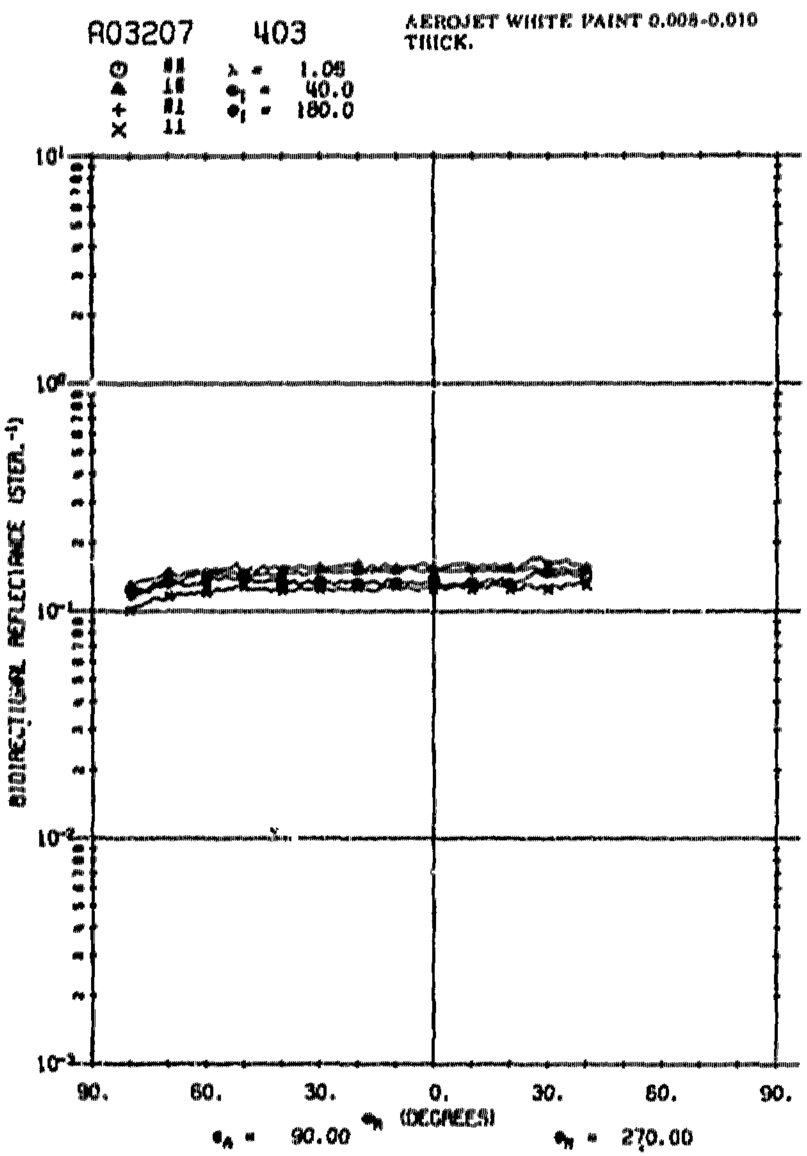
AEROJET WHITE PAINT 0.008-0.010 THICK.
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)

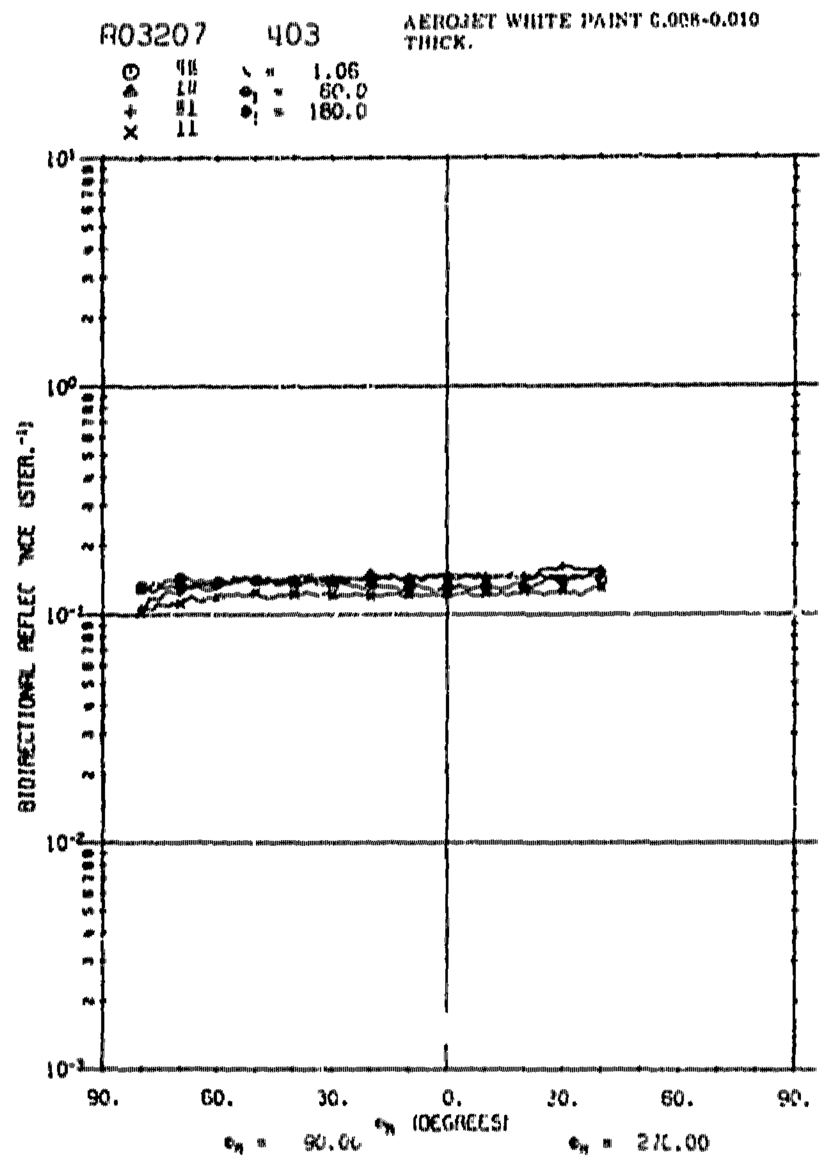

A03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
⊙ NN
▲ 1N
+ N1
X 11
λ = 1.06
θi = 20.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00
φR = 180.00

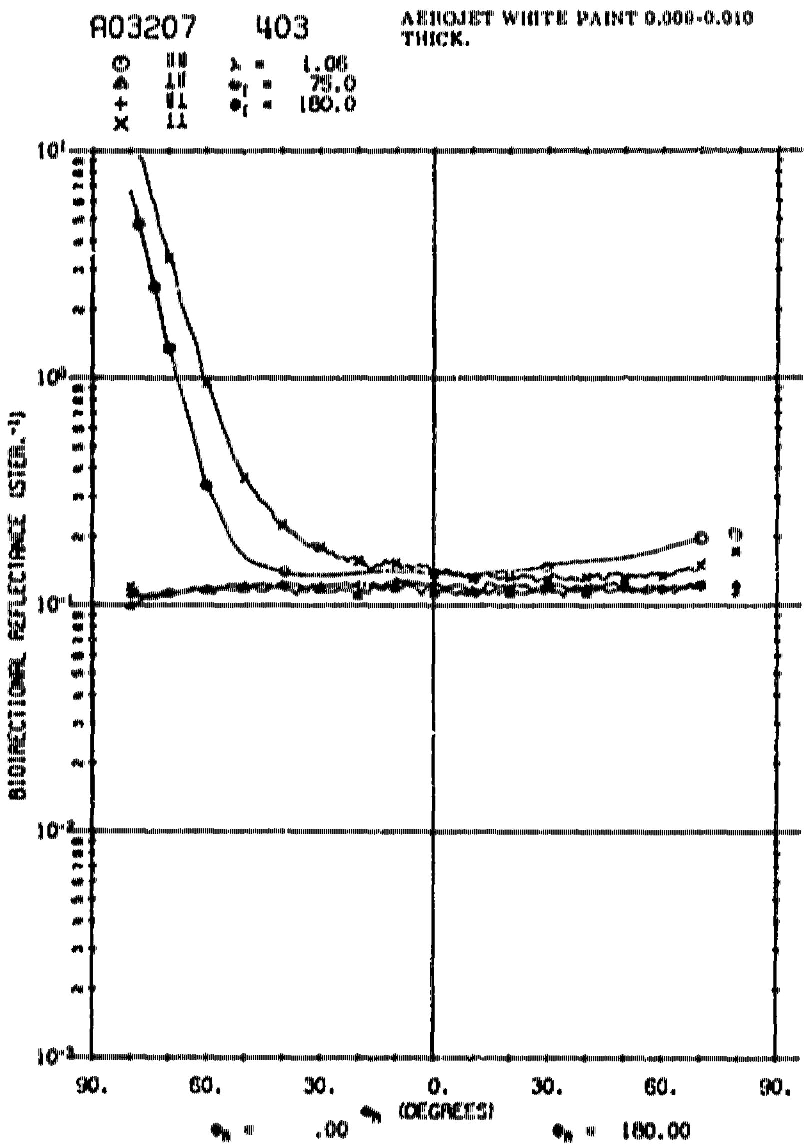

A03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = 1.06
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.-1)
θR (DEGREES)
φR = .00
φR = 180.00

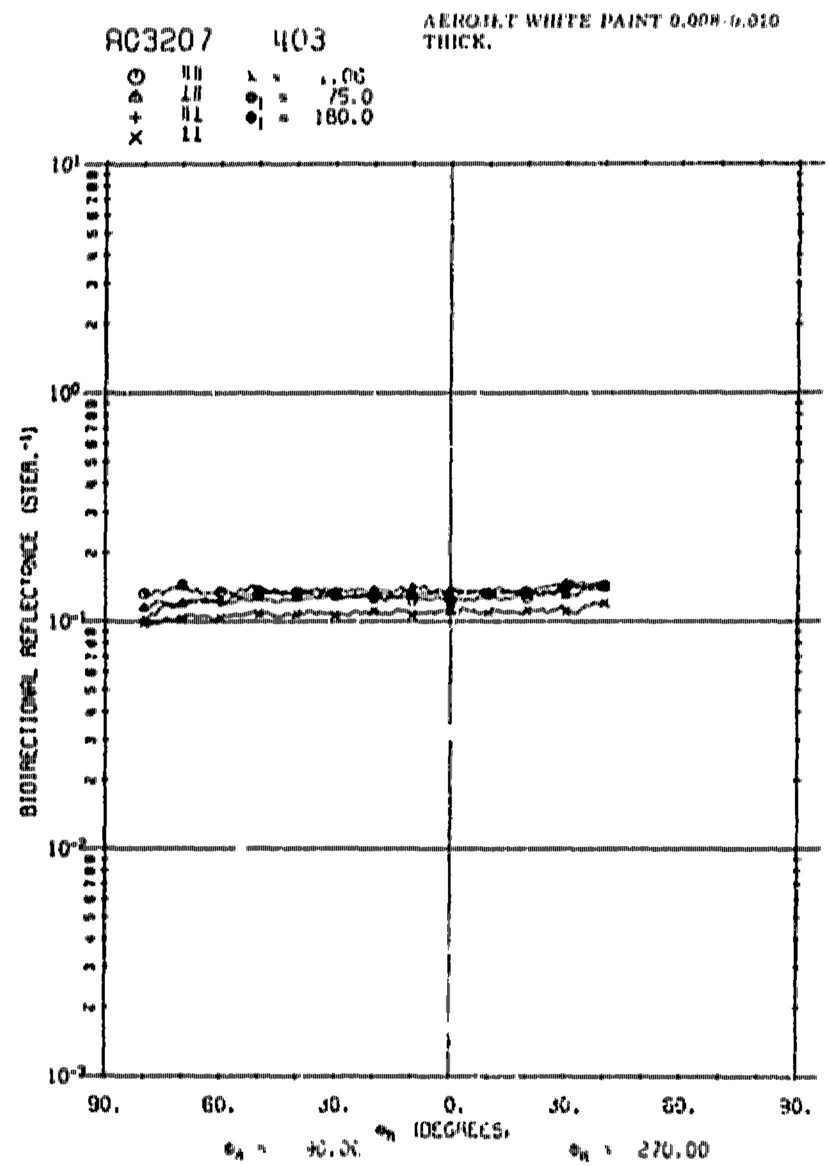

A03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = 1.06
θ_I = 60.0
ϕ_I = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180 00


AEROJET WHITE PAINT 0.008-0.010 THICK.
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)


R03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = 1.06
θi = 40.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = 90.00
φR = 270.00


R03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = 1.06
θi = 60.0
φi = 180.0
BIDIRECTIONAL REFLECTANCE (STER.⁻¹)
90. 60. 30. 0. 30. 60. 90.
θR (DEGREES)
φR = 90.00
φR = 270.00


A03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
λ = 1.06
θ_i = 75.0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = .00
ϕ_R = 180.00


A03207 403
AEROJET WHITE PAINT 0.008-0.010 THICK.
θ_i = 75.0
ϕ_i = 180.0
BIDIRECTIONAL REFLECTANCE (STER.$^{-1}$)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
90. 60. 30. 0. 30. 60. 90.
θ_R (DEGREES)
ϕ_R = 270.00

Appendix D
SPECULAR BIDIRECTIONAL REFLECTANCE DATA

This appendix contains a computer listing of the bull's-eye representation of the specular bidirectional reflectance data. The bull's-eye is a 5- or 6-element representation of the 99-element measurement matrix of the ρ' value of various materials having highly specular characteristics. Each line on the computer listing gives a bull's-eye representation of a particular 99-element matrix. As well as the numbers associated with the bull's-eye itself, the pertinent measurement parameters are also given.

Table D-1 gives the formats used and presents a list of the information which also appears in the listing. A second table, Table D-2, is provided as a quick reference to the polarization alignment (PCODE) used to define the relationship of the source and receiver polarization as measured with respect to their reference planes. The reference planes are defined by the sample normal and a vector from the base of the sample normal to the source or receiver. When specifying a PCODE as, say, parallel, parallel, one should note that the source polarization is always specified first. The polarization code is further defined in Appendix D in accordance with the ERAS format.

A summary of the specular bidirectional reflectance measurements performed is presented in Table D-3. The summary includes a sample description and the measurement parameters.

All of the data shown is available from ERIM either on computer cards or on magnetic tape.

TABLE D-1. DATA CARD FORMAT

Column	Description	Column Format Code
1-4	Sample number	I4
5-7	Area Condition number	I3
8	Manufacturer code A for Aerojet, C for Centralab, H for Heliotek, and T for TRW.	A1
9	An X for the second specular reflection from a Centralab solar cell	A1
11	Polarization code, see Table D-2	I1
13-16	Source wavelength, .55 used to indicate .4-.7 μm broad-band white light source	F4.2
17-21	Phi, ϕ_r, of the receiver	F5.1
22-26	Theta, θ_r, of the receiver	F5.1
27-35	Bullseye ring 0^o-$.1^o$	F9.1
36-44	Bullseye ring $.1^o$-$.2^o$	F9.1
45-53	Bullseye ring $.2^o$-$.3^o$	F9.1
54-62	Bullseye ring $.3^o$-$.4^o$	F9.1
63-71	Bullseye ring $.4^o$-$.7^o$	F9.1
72-80	Bullseye ring $.7^o$-1.0^o	F9.1

TABLE D-2. PCODE SYMBOLS

PCODE	Symbol	Description
2	$\parallel \parallel$	Parallel, Parallel
3	$\perp \parallel$	Perpendicular, Parallel
4	$\parallel \perp$	Parallel, Perpendicular
5	$\perp \perp$	Perpendicular, Perpendicular
6	$0 \parallel$	Unpolarized, Parallel
7	$0 \perp$	Unpolarized, Perpendicular

TABLE D-3. SUMMARY OF BULL'S-EYE REFLECTANCE DATA

Description	Sample No.	Area	PCODE	λ	ϕ
TRW 2nd Surface Mirror Array	3165	502	6,7	.55	.0
TRW 2nd Surface Mirror Array	3165	602	6,7	.55	.0
TRW 2nd Surface Mirror Array	3165	702	6,7	.55	.0
TRW 2nd Surface Mirror Array	3165	501	2,3,4,5	.63	90.0
TRW 2nd Surface Mirror Array	3165	601	2,3,4,5	.63	90.0
TRW 2nd Surface Mirror Array	3165	701	2,3,4,5	.63	90.0
TRW 2nd Surface Mirror Array	3165	503	2,3,4,5	1.06	.0
TRW 2nd Surface Mirror Array	3165	603	2,3,4,5	1.06	.0
TRW 2nd Surface Mirror Array	3165	703	2,3,4,5	1.06	.0
Solar Cell Array, H-Type	3179	501	6,7	.55	.0
Solar Cell Array, H-Type	3179	502	6,7	.55	270.0
Solar Cell Array, H-Type	3179	601	6,7	.55	.0
Solar Cell Array, H-Type	3179	602	6,7	.55	270.0
Solar Cell Array, H-Type	3179	701	6,7	.55	.0
Solar Cell Array, H-Type	3179	702	6,7	.55	270.0
Solar Cell Array, C-Type	3181	501	6,7	.55	.0
Solar Cell Array, C-Type	3181	503	6,7	.55	270.0
Solar Cell Array, C-Type	3181	601	6,7	.55	.0
Solar Cell Array, C-Type	3181	603	6,7	.55	270.0
Solar Cell Array, C-Type	3181	701	6,7	.55	.0

TABLE D-3. SUMMARY OF BULL'S-EYE REFLECTANCE DATA (Continued)

Description	Sample No.	Area	PCODE	λ	Φ
Solar Cell Array, C-Type	3181	703	6,7	.55	270.0
Solar Cell Array, C-Type	3181	502	6,7	.55	.0
Solar Cell Array, C-Type	3181	504	6,7	.55	270.0
Solar Cell Array, C-Type	3181	602	6,7	.55	.0
Solar Cell Array, C-Type	3181	604	6,7	.55	270.0
Solar Cell Array, C-Type	3181	702	6,7	.55	.0
Solar Cell Array, C-Type	3181	704	6,7	.55	270.0
Solar Cell Array, H-Type	3182	403	6,7	.55	180.0
Solar Cell Array, H-Type	3182	404	6,7	.55	270.0
Solar Cell Array, H-Type	3182	503	6,7	.55	180.0
Solar Cell Array, H-Type	3182	504	6,7	.55	270.0
Solar Cell Array, H-Type	3182	603	6,7	.55	180.0
Solar Cell Array, H-Type	3182	604	6,7	.55	270.0
Solar Cell Array, H-Type	3182	608	6,7	.55	280.0
Solar Cell Array, H-Type	3182	609	6,7	.55	45.0
Solar Cell Array, H-Type	3182	401	2,3,4,5	.63	180.0
Solar Cell Array, H-Type	3182	402	2,3,4,5	.63	270.0
Solar Cell Array, H-Type	3182	501	2,3,4,5	.63	270.0
Solar Cell Array, H-Type	3182	502	2,3,4,5	.63	180.0
Solar Cell Array, H-Type	3182	601	2,3,4,5	.63	180.0

TABLE D-3. SUMMARY OF BULL'S-EYE REFLECTANCE DATA (Continued)

Description	Sample No.	Area	PCODE	λ	φ
Solar Cell Array, H-Type	3182	602	2,3,4,5	.63	270.0
Solar Cell Array, H-Type	3182	406	2,3,4,5	1.06	270.0
Solar Cell Array, H-Type	3182	407	2,3,4,5	1.06	.0
Solar Cell Array, H-Type	3182	506	2,3,4,5	1.06	270.0
Solar Cell Array, H-Type	3182	507	2,3,4,5	1.06	.0
Solar Cell Array, H-Type	3182	606	2,3,4,5	1.06	270.0
Solar Cell Array, H-Type	3182	607	2,3,4,5	1.06	.0
Solar Cell Array, H-Type	3183	501	6,7	.55	.0
Solar Cell Array, H-Type	3183	502	6,7	.55	270.0
Solar Cell Array, H-Type	3183	601	6,7	.55	.0
Solar Cell Array, H-Type	3183	602	6,7	.55	270.0
Solar Cell Array, H-Type	3183	701	6,7	.55	.0
Solar Cell Array, H-Type	3183	702	6,7	.55	270.0
Solar Cell Array, C-Type	3184	406	6,7	.55	180.0
Solar Cell Array, C-Type	3184	408	6,7	.55	270.0
Solar Cell Array, C-Type	3184	506	6,7	.55	270.0
Solar Cell Array, C-Type	3184	508	6,7	.55	180.0
Solar Cell Array, C-Type	3184	606	6,7	.55	180.0
Solar Cell Array, C-Type	3184	608	6,7	.55	270.0
Solar Cell Array, C-Type	3184	405	6,7	.55	180.0

TABLE D-3. SUMMARY OF BULL'S-EYE REFLECTANCE DATA (Continued)

Description	Sample No.	Area	PCODE	λ	ϕ
Solar Cell Array, C-Type	3184	407	6,7	.55	270.0
Solar Cell Array, C-Type	3184	505	6,7	.55	270.0
Solar Cell Array, C-Type	3184	507	6,7	.55	180.0
Solar Cell Array, C-Type	3184	605	6,7	.55	180.0
Solar Cell Array, C-Type	3184	607	6,7	.55	270.0
Solar Cell Array, C-Type	3184	401	2,3,4,5	.63	180.0
Solar Cell Array, C-Type	3184	404	2,3,4,5	.63	270.0
Solar Cell Array, C-Type	3184	502	2,3,4,5	63	270.0
Solar Cell Array, C-Type	3184	602	2,3,4,5	.63	180.0
Solar Cell Array, C-Type	3184	702	2,3,4,5	.63	180.0
Solar Cell Array, C-Type	3184	704	2,3,4,5	.63	270.0
Solar Cell Array, C-Type	3184	402	2,3,4,5	.63	180.0
Solar Cell Array, C-Type	3184	403	2,3,4,5	.63	270.0
Solar Cell Array, C-Type	3184	501	2,3,4,5	.63	270.0
Solar Cell Array, C-Type	3184	601	2,3,4,5	.63	180.0
Solar Cell Array, C-Type	3184	701	2,3,4,5	.63	180.0
Solar Cell Array, C-Type	3184	703	2,3,4,5	.63	90.0
Solar Cell Array, C-Type	3184	409	2,3,4,5	1.06	.0
Solar Cell Array, C-Type	3184	411	2,3,4,5	1.06	270.0
Solar Cell Array, C-Type	3184	412	2,3,4,5	1.06	270.0

TABLE D-3. SUMMARY OF BULL'S-EYE REFLECTANCE DATA (Continued)

Description	Sample No.	Area	PCODE	λ	Φ
Solar Cell Array, C-Type	3184	509	2,3,4,5	1.06	.0
Solar Cell Array, C-Type	3184	511	2,3,4,5	1.06	270.0
Solar Cell Array, C-Type	3184	609	2,3,4,5	1.06	.0
Solar Cell Array, C-Type	3184	611	2,3,4,5	1.06	270.0
Solar Cell Array, C-Type	3184	410	2,3,4,5	1.06	.0
Solar Cell Array, C-Type	3184	510	2,3,4,5	1.06	.0
Solar Cell Array, C-Type	3184	512	2,3,4,5	1.06	270.0
Solar Cell Array, C-Type	3184	610	2,3,4,5	1.06	.0
Solar Cell Array C-Type	3184	612	2,3,4,5	1.06	270.0
Solar Cell Array, C-Type	3185	501	6,7	.55	.0
Solar Cell Array, C-Type	3185	503	6,7	.55	270.0
Solar Cell Array, C-Type	3185	601	6,7	.55	.0
Solar Cell Array, C-Type	3185	603	6,7	.55	270.0
Solar Cell Array, C-Type	3185	701	6,7	.55	.0
Solar Cell Array, C-Type	3185	703	6,7	.55	270.0
Solar Cell Array, C-Type	3185	502	6,7	.55	.0
Solar Cell Array, C-Type	3185	504	6,7	.55	270.0
Solar Cell Array, C-Type	3185	602	6,7	.55	.0
Solar Cell Array, C-Type	3185	604	6,7	.55	270.0
Solar Cell Array, C-Type	3185	702	6,7	.55	.0

TABLE D-3. SUMMARY OF BULL'S-EYE REFLECTANCE DATA (Concluded)

Description	Sample No.	Area	PCODE	λ	ϕ
Solar Cell Array, C-Type	3185	704	6,7	.55	270.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	402	6,7	.55	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	502	6,7	.55	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	602	6,7	.55	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	401	2,3,4,5	.63	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	501	2,3,4,5	.63	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	601	2,3,4,5	.63	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	403	2,3,4,5	1.06	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	503	2,3,4,5	1.06	.0
Aerojet 2nd Surface Mirror Array, (MG Substrate - RTV 566 Backing)	3190	603	2,3,4,5	1.06	.0
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate RTV 615)	3194	501	6,7	.55	270.0
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate RTV 615)	3194	601	6,7	.55	180.0
Aerojet 2nd Surface Mirror Array, (Fiberglass Substrate RTV 615)	3194	701	6,7	.55	90.0

SAMPLE A C MFG PRIME	P CODE	λ	φ	θ	0^{o}-.1^{o}	.1^{o}-.2^{o}	.2^{o}-.3^{o}	.3^{o}-.4^{o}	.4^{o}-.7^{o}	.7^{o}-1.0^{o}
3165502T	6	.55	.0	5.0	5015.4	4439.0	3189.6	1739.0	384.7	
3165502T	7	.55	.0	5.0	5278.5	4597.0	3253.5	1753.1	386.3	
3165502T	6	.55	.0	20.0	5115.5	4401.2	3003.1	1574.4	415.7	
3165502T	7	.55	.0	20.0	5071.9	4308.3	3078.0	1709.0	465.0	
3165502T	6	.55	.0	40.0	8904.3	6742.4	4016.7	1625.5	266.7	
3165502T	7	.55	.0	40.0	8955.1	6640.8	4024.1	1740.7	307.7	
3165502T	6	.55	.0	60.0	9740.4	8317.3	5784.6	3192.0	986.2	
3165502T	7	.55	.0	60.0	9151.9	8993.1	5971.0	3184.7	927.5	
3165602T	6	.55	.0	5.0	6955.1	5229.3	3121.0	1119.9	262.9	
3165602T	7	.55	.0	5.0	6835.3	5056.2	2995.9	1061.9	192.5	
3165602T	6	.55	.0	20.0	6609.8	5086.0	2713.0	910.5	150.6	
3165602T	7	.55	.0	20.0	6528.4	4965.5	2624.6	868.8	137.5	
3165602T	6	.55	.0	40.0	8231.7	6289.9	3567.0	1225.2	164.1	
3165602T	7	.55	.0	40.0	8076.5	6160.7	3502.9	1199.7	164.7	
3165602T	6	.55	.0	60.0	17066.3	12194.1	5611.1	2027.3	282.6	
3165602T	7	.55	.0	60.0	16699.9	11972.0	5628.7	2083.0	308.9	
3165702T	6	.55	.0	5.0	10254.3	7041.6	2977.4	753.2	126.2	
3165702T	7	.55	.0	5.0	10117.9	6969.4	3095.8	753.8	113.5	
3165702T	6	.55	.0	20.0	5647.9	4773.6	3308.6	1833.2	406.0	
3165702T	7	.55	.0	20.0	5545.4	4718.8	3304.9	1717.6	324.9	
3165702T	6	.55	.0	40.0	7962.8	7797.7	5806.5	2817.1	509.2	
3165702T	7	.55	.0	40.0	9961.6	8717.1	5950.0	2546.4	389.5	
3165702T	6	.55	.0	60.0	19308.6	11892.7	8997.7	4360.1	1583.8	
3165702T	7	.55	.0	60.0	24692.0	18972.1	10339.1	3358.1	549.8	
3165501T	2	.63	90.0	5.0	17899.1	15343.9	3451.3	425.7	50.1	
3165501T	3	.63	90.0	5.0	903.3	302.0	50.5	7.5	3.0	
3165501T	4	.63	90.0	5.0	904.0	848.9	209.4	22.8	6.0	
3165501T	5	.63	90.0	5.0	30497.0	11773.0	2025.2	285.1	41.2	
3165501T	2	.63	90.0	20.0	25498.6	10839.8	2411.8	328.2	36.2	
3165501T	3	.63	90.0	20.0	1036.6	487.6	110.5	19.7	5.0	
3165501T	4	.63	90.0	20.0	141.2	90.5	26.8	5.9	3.7	
3165501T	5	.63	90.0	20.0	37411.9	17338.8	4510.9	628.6	64.4	
3165501T	2	.63	90.0	40.0	23376.6	19093.0	3067.4	340.0	48.8	
3165501T	3	.63	90.0	40.0	3090.8	2095.2	217.0	17.7	4.4	
3165501T	4	.63	90.0	40.0	1203.7	982.8	129.3	13.5	4.2	
3165501T	5	.63	90.0	40.0	47667.7	17564.9	2944.5	408.1	74.1	
3165501T	2	.63	90.0	60.0	24036.7	23654.0	11830.9	2189.3	104.5	
3165501T	3	.63	90.0	60.0	1734.8	1192.0	498.8	31.7	4.5	
3165501T	4	.63	90.0	60.0	1039.1	1240.9	743.5	153.2	12.2	
3165501T	5	.63	90.0	60.0	52612.0	32412.6	11138.3	713.7	33.7	
3165601T	2	.63	90.0	5.0	21169.1	[illegible]	5939.1	2194.8	69.7	
3165601T	3	.63	90.0	5.0	674.5	637.8	203.8	50.1	13.3	
3165601T	4	.63	90.0	5.0	875.6	541.9	147.0	14.3	5.3	
3165601T	5	.63	90.0	5.0	13033.0	12266.7	4518.1	992.5	192.9	
3165601T	2	.63	90.0	20.0	26794.0	21050.7	9026.1	1620.9	31.3	
3165601T	3	.63	90.0	20.0	993.9	430.1	182.9	110.6	14.6	
3165601T	4	.63	90.0	20.0	941.6	630.1	377.0	94.4	6.5	
3165601T	5	.63	90.0	20.0	33782.3	11252.6	3382.3	950.3	144.4	
3165601T	2	.63	90.0	40.0	19221.6	17140.4	4020.3	525.0	49.2	
3165601T	3	.63	90.0	40.0	652.2	445.7	79.1	13.0	3.6	
3165601T	4	.63	90.0	40.0	605.9	558.7	152.9	27.0	7.3	
3165601T	5	.63	90.0	40.0	24236.2	17466.5	3234.0	639.8	294.1	
3165601T	2	.63	90.0	60.0	47980.6	16054.4	4089.3	677.6	43.2	
3165601T	3	.63	90.0	60.0	1612.9	641.2	97.2	15.4	4.5	
3165601T	4	.63	90.0	60.0	1544.2	521.7	151.7	31.8	9.5	
3165601T	5	.63	90.0	60.0	69024.2	27737.1	3485.4	333.7	37.5	
3165701T	2	.63	90.0	5.0	16610.7	13637.7	6221.2	906.9	88.8	
3165701T	3	.63	90.0	5.0	392.9	302.6	158.4	42.8	3.1	
3165701T	4	.63	90.0	5.0	682.5	501.0	207.2	32.5	8.0	
3165701T	5	.63	90.0	5.0	13732.5	9451.1	4503.7	1198.2	55.7	
3165701T	2	.63	90.0	20.0	14453.0	12240.9	4976.5	678.2	30.3	

SAMPLE	A C MFG PRIME P CODE	λ	φ	[illegible]	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3165701T	3	.63	90.0	20.0	650.8	334.8	115.0	22.2	2.3	
3165701T	4	.63	90.0	20.0	811.8	458.3	152.7	25.2	5.7	
3165701T	5	.63	90.0	20.0	21999.1	11693.1	4330.1	952.3	98.2	
3165701T	2	.63	90.0	40.0	31622.3	18114.9	5363.2	771.9	45.4	
3165701T	3	.63	90.0	40.0	552.0	379.4	129.8	27.6	4.0	
3165701T	4	.63	90.0	40.0	870.5	559.1	129.7	10.6	4.1	
3165701T	5	.63	90.0	40.0	24542.8	15128.1	4912.2	950.9	54.6	
3165701T	2	.63	90.0	60.0	10959.1	10671.8	5149.0	871.7	74.2	
3165701T	3	.63	90.0	60.0	771.0	507.2	207.2	68.3	12.2	
3165701T	4	.63	90.0	60.0	1230.7	633.4	172.6	29.3	8.6	
3165701T	5	.63	90.0	60.0	33053.0	20656.1	8161.2	2712.1	358.1	
3165503T	2	1.06	.0	5.0	51272.1	21863.2	5622.5	1053.2	159.6	
3165503T	3	1.06	.0	5.0	473.0	358.1	154.1	39.0	9.5	
3165503T	4	1.06	.0	5.0	661.0	276.8	75.3	23.1	8.5	
3165503T	5	1.06	.0	5.0	35950.1	24326.2	9216.0	2389.6	391.1	
3165503T	2	1.06	.0	20.0	49069.7	28681.5	7254.3	1389.7	264.6	
3165503T	3	1.06	.0	20.0	440.5	263.2	84.1	28.8	12.4	
3165503T	4	1.06	.0	20.0	668.8	384.2	102.2	22.9	9.1	
3165503T	5	1.06	.0	20.0	40500.3	23600.4	7496.9	1993.0	494.4	
3165503T	2	1.06	.0	40.0	23613.5	14287.1	6888.6	3317.0	778.2	
3165503T	3	1.06	.0	40.0	457.5	285.3	146.1	47.6	18.6	
3165503T	4	1.06	.0	40.0	282.4	191.5	99.8	37.5	15.0	
3165503T	5	1.06	.0	40.0	33891.1	24228.5	11642.0	3869.8	1074.8	
3165503T	2	1.06	.0	60.0	50726.0	41459.2	20635.0	4308.4	938.6	
3165503T	3	1.06	.0	60.0	461.7	666.4	483.6	156.2	42.6	
3165503T	4	1.06	.0	60.0	664.3	551.4	278.7	70.2	29.7	
3165503T	5	1.06	.0	60.0	35772.6	47969.9	35251.1	8826.3	1567.0	
3165603T	2	1.06	.0	5.0	28960.9	21852.6	6660.9	1564.8	418.8	
3165603T	3	1.06	.0	5.0	352.6	79.4	13.3	4.7	4.0	
3165603T	4	1.06	.0	5.0	264.7	169.9	48.6	12.2	7.4	
3165603T	5	1.06	.0	5.0	43440.5	11625.1	1924.4	273.6	51.5	
3165603T	2	1.06	.0	20.0	32023.2	24934.7	15085.5	2856.[illegible]	508.9	
3165603T	3	1.06	.0	20.0	227.8	94.4	16.2	7.[illegible]	4.5	
3165603T	4	1.06	.0	20.0	220.5	194.9	113.7	25.1	9.4	
3165603T	5	1.06	.0	20.0	39989.5	14826.2	1960.4	341.2	51.3	
3165603T	2	1.06	.0	40.0	16294.8	14614.3	6265.5	1917.8	485.3	
3165603T	3	1.06	.0	40.0	348.2	102.3	17.8	6.1	5.6	
3165603T	4	1.06	.0	40.0	145.6	140.8	69.7	27.8	12.2	
3165603T	5	1.06	.0	40.0	50792.0	14292.9	1960.4	297.8	55.5	
3165603T	2	1.06	.0	60.0	60325.5	22391.0	5923.0	1715.4	415.0	
3165603T	3	1.06	.0	60.0	390.9	294.0	168.4	56.7	15.5	
3165603T	4	1.06	.0	60.0	638.8	294.4	76.5	27.3	13.3	
3165603T	5	1.06	.0	60.0	34260.8	19807.4	10216.7	3141.7	485.6	
3165703T	2	1.06	.0	5.0	37621.5	15607.1	3351.6	184.2	23.8	
3165703T	3	1.06	.0	5.0	485.4	224.1	34.[illegible]	7.1	4.0	
3165703T	4	1.06	.0	5.0	534.1	222.7	46.8	6.7	4.6	
3165703T	5	1.06	.0	5.0	36737.[illegible]	15903.1	2016.8	177.5	20.7	
3165703T	2	1.06	.0	20.0	3640[illegible].5	16279.5	2283.1	265.3	36.7	
3165703T	3	1.06	.0	20.0	45[illegible].2	225.9	43.[illegible]	6.8	4.5	
3165703T	4	1.06	.0	20.0	43[illegible].5	198.7	32.7	7.2	3.9	
3165703T	5	1.06	.0	20.0	39176.5	18059.0	3036.3	160.9	13.8	
3165703T	2	1.06	.0	40.0	35340.9	22260.0	4742.4	634.5	106.2	
3165703T	3	1.06	.0	40.0	[illegible]78.2	223.8	37.3	7.6	4.1	
3165703T	4	1.06	.0	40.0	556.2	293.[illegible]	51.9	8.3	5.0	
3165703T	5	1.06	.0	40.0	41360.2	16637.4	2865.4	328.6	54.2	
3165703T	2	1.06	.0	60.0	68411.0	23802.0	1494.5	103.5	23.4	
3165703T	3	1.06	.0	60.0	895.9	418.4	104.4	27.5	7.6	
3165703T	4	1.06	.0	60.0	1002.9	347.8	41.0	12.2	8.1	
3165703T	5	1.06	.0	60.0	55299.8	25185.5	6622.7	1241.3	113.7	
3179501F	6	.55	.0	5.0	111.5	108.2	105.4	81.1	43.5	9.8
3179501F	7	.55	.0	5.0	112.0	104.2	100.9	82.1	43.7	9.6

SAMPLE / A C / MFG / PRIME	P CODE	λ	φ	"	$0^0-.1^0$	$.1^0-.2^0$	$.2^0-.3^0$	$.3^0-.4^0$	$.4^0-.7^0$	$.7^0-1.0^0$
3179501F	6	.55	.0	20.0	105.7	99.9	96.1	71.8	36.4	7.8
3179501F	7	.55	.0	20.0	146.0	127.4	119.7	129.7	75.3	13.0
3179501F	6	.55	.0	40.0	63.4	52.9	49.4	33.9	16.5	5.8
3179501F	7	.55	.0	40.0	208.7	189.6	178.4	116.9	50.2	9.5
3179501F	6	.55	.0	60.0	57.7	62.1	60.6	43.8	21.5	6.6
3179501F	7	.55	.0	60.0	612.9	488.3	449.7	322.0	146.6	20.9
3179502F	6	.55	270.0	5.0	91.4	92.5	91.9	73.4	39.9	9.9
3179502F	7	.55	270.0	5.0	95.4	96.8	96.6	76.5	40.5	9.7
3179502F	6	.55	270.0	20.0	118.0	109.5	105.5	74.5	34.6	8.1
3179502F	7	.55	270.0	20.0	161.3	146.3	139.5	98.4	44.4	3.8
3179502F	6	.55	270.0	40.0	64.9	54.1	49.8	35.3	18.5	6.9
3179502F	7	.55	270.0	40.0	268.2	207.9	185.0	123.7	55.2	10.9
3179502F	6	.55	270.0	60.0	90.4	72.4	65.5	44.5	21.3	7.1
3179502F	7	.55	270.0	60.0	808.4	619.7	548.1	339.8	137.6	22.0
3179601F	6	.55	.0	5.0	347.1	234.1	197.3	97.1	33.6	10.2
3179601F	7	.55	.0	5.0	341.5	237.7	201.3	98.5	33.1	10.0
3179601F	6	.55	.0	20.0	294.3	199.8	168.7	84.2	28.9	10.0
3179601F	7	.55	.0	20.0	361.7	249.7	212.1	105.3	34.7	10.7
3179601F	6	.55	.0	40.0	172.1	105.[illegible]	86.0	40.2	15.4	8.9
3179601F	7	.55	.0	40.0	537.2	342.[illegible]	276.6	120.0	33.8	10.9
3179601F	6	.55	.0	60.0	247.0	143.0	111.1	90.3	49.7	21.9
3179601F	7	.55	.0	60.0	1714.7	1029.4	797.5	321.3	80.9	19.3
3179602F	6	.55	270.0	5.0	215.8	160.5	143.6	89.3	39.9	10.3
3179602F	7	.55	270.0	5.0	182.1	155.5	141.6	91.2	39.8	10.4
3179602F	6	.55	270.0	20.0	159.9	145.3	132.4	79.8	31.3	9.0
3179602F	7	.55	270.0	20.0	256.2	190.1	167.7	96.0	37.0	9.3
3179602F	6	.55	270.0	40.0	96.3	84.6	77.0	46.5	20.6	8.7
3179602F	7	.55	270.0	40.0	416.7	280.1	239.9	128.2	45.5	10.5
3179602F	6	.55	270.0	60.0	183.3	130.4	112.9	63.6	24.2	9.4
3179602F	7	.55	270.0	60.0	1558.6	909.3	757.6	426.7	132.3	15.0
3179701F	6	.55	.0	5.0	158.7	120.4	108.3	68.1	29.4	6.6
3179701F	7	.55	.0	5.0	132.6	125.8	116.9	70.6	30.1	6.9
3179701F	6	.55	.0	20.0	140.5	116.9	105.9	60.5	22.0	6.1
3179701F	7	.55	.0	20.0	197.1	155.6	139.2	78.5	27.6	6.6
3179701F	6	.55	.0	40.0	68.8	55.3	50.6	32.9	14.1	5.3
3179701F	7	.55	.0	40.0	229.6	203.8	186.5	112.2	37.6	6.7
3179701F	6	.55	.0	60.0	120.6	94.4	85.2	47.7	17.6	6.5
3179701F	7	.55	.0	60.0	687.9	609.6	566.0	312.8	97.4	15.2
3179702F	6	.55	270.0	5.0	193.3	132.3	108.7	66.0	27.7	8.5
3179702F	7	.55	270.0	5.0	193.7	134.1	110.8	67.3	28.0	8.7
3179702F	6	.55	270.0	20.0	162.2	125.9	113.3	71.0	28.9	9.0
3179702F	7	.55	270.0	20.0	218.8	166.9	148.6	87.6	34.3	10.1
3179702F	6	.55	270.0	40.0	95.7	66.9	57.3	33.3	15.4	9.0
3179702F	7	.55	270.0	40.0	375.4	265.3	228.5	118.7	38.3	10.5
3179702F	6	.55	270.0	60.0	160.6	99.9	81.0	40.6	17.8	13.0
3179702F	7	.55	270.0	60.0	1464.5	878.6	688.7	297.3	75.4	14.8
3181501C	6	.55	.0	5.0	291.8	249.0	178.9	105.7	45.6	
3181501C	7	.55	.0	5.0	295.0	253.7	184.2	107.1	45.1	
3181501C	6	.55	.0	20.0	230.8	182.3	114.7	64.7	26.1	
3181501C	7	.55	.0	20.0	237.2	187.8	117.6	67.1	26.3	
3181501C	6	.55	.0	40.0	251.5	204.6	151.1	91.6	36.9	
3181501C	7	.55	.0	40.0	262.9	217.5	160.4	97.1	39.7	
3181501C	6	.55	.0	60.0	301.7	269.7	211.0	146.1	79.0	
3181501C	7	.55	.0	60.0	274.3	246.4	196.1	136.3	75.6	
3181503C	6	.55	270.0	5.0	310.7	296.5	228.6	153.0	72.6	
3181503C	7	.55	270.0	5.0	322.4	284.9	224.4	154.0	75.2	
3181503C	6	.55	270.0	20.0	268.5	253.5	207.2	146.3	82.9	
3181503C	7	.55	270.0	20.0	260.9	252.9	206.6	143.6	80.4	
3181503C	6	.55	270.0	40.0	313.5	304.1	258.0	179.5	73.9	
3181503C	7	.55	270.0	40.0	324.7	312.3	267.4	183.9	76.9	
3181503C	6	.55	270.0	60.0	332.6	303.3	256.9	200.8	98.5	

SAMPLE	A C MEG PRIME P CODE				0^0-.1^0	.1^0-.2^0	.2^0-.3^0	.3^0-.4^0	.4^0-.7^0	.7^0-1.0^0
3181503C	7	.55	270.0	60.0	270.6	239.3	240.8	195.8	97.0	
3181601C	6	.55	.0	5.0	355.5	289.7	177.5	96.3	38.7	
3181601C	7	.55	.0	5.0	371.0	306.3	186.4	99.2	38.2	
3181601C	6	.55	.0	20.0	388.1	311.8	187.1	102.1	36.7	
3181601C	7	.55	.0	20.0	376.8	305.9	188.4	105.6	39.9	
3181601C	6	.55	.0	40.0	434.4	361.2	247.4	131.9	46.8	
3181601C	7	.55	.0	40.0	432.7	353.4	241.3	127.5	45.2	
3181601C	6	.55	.0	60.0	532.3	454.3	330.6	193.0	68.8	
3181601C	7	.55	.0	60.0	391.6	347.1	254.4	149.2	58.4	
3181503C	6	.55	270.0	5.0	370.4	283.5	160.3	66.5	16.0	
3181603C	7	.55	270.0	5.0	385.6	288.3	160.5	64.6	14.0	
3181603C	6	.55	270.0	20.0	246.0	202.9	133.4	69.7	24.2	
3181603C	7	.55	270.0	20.0	287.0	219.9	136.7	63.6	21.9	
3181603C	6	.55	270.0	40.0	268.9	225.7	156.7	77.5	19.1	
3181603C	7	.55	270.0	40.0	259.7	223.4	154.5	75.5	16.4	
3181603C	6	.55	270.0	60.0	192.3	171.1	125.6	80.6	22.8	
3181603C	7	.55	270.0	60.0	154.2	137.2	106.1	74.3	30.2	
3181701C	6	.55	.0	5.0	160.8	142.8	106.0	67.5	29.4	
3181701C	7	.55	.0	5.0	163.2	144.2	103.7	67.1	28.4	
3181701C	6	.55	.0	20.0	175.5	163.5	135.1	94.3	47.2	
3181701C	7	.55	.0	20.0	172.7	162.3	135.2	98.9	49.8	
3181701C	6	.55	.0	40.0	160.7	146.8	131.6	106.0	48.2	
3181701C	7	.55	.0	40.0	157.5	147.9	130.3	103.2	52.4	
3181701C	6	.55	.0	60.0	155.6	137.4	111.6	95.0	52.1	
3181701C	7	.55	.0	60.0	141.5	130.3	117.2	107.4	74.4	
3181703C	6	.55	270.0	5.0	367.5	292.6	188.1	99.3	51.5	
3181703C	7	.55	270.0	5.0	358.9	288.4	188.0	100.7	52.7	
3181703C	6	.55	270.0	20.0	235.6	222.5	159.9	89.1	48.5	
3181703C	7	.55	270.0	20.0	228.5	221.4	159.6	88.7	49.1	
3181703C	6	.55	270.0	40.0	412.9	337.3	226.3	125.5	72.1	
3181703C	7	.55	270.0	40.0	396.1	325.2	218.0	121.6	70.6	
3181703C	6	.55	270.0	60.0	246.0	245.4	226.5	183.1	121.2	
3181703C	7	.55	270.0	60.0	214.0	212.9	197.0	160.9	109.3	
3181502CX	6	.55	.0	5.0	280.5	220.2	123.3	52.7	17.4	
3181502CX	7	.55	.0	5.0	274.6	210.9	119.2	51.3	18.7	
3181502CX	6	.55	.0	20.0	218.0	179.2	101.4	46.6	17.0	
3181502CX	7	.55	.0	20.0	294.9	234.3	130.8	59.7	19.7	
3181502CX	6	.55	.0	40.0	151.0	109.0	54.4	20.6	5.5	
3181502CX	7	.55	.0	40.0	503.9	366.1	182.3	64.2	14.7	
3181502CX	6	.55	.0	60.0	237.7	158.7	70.0	27.2	4.1	
3181502CX	7	.55	.0	60.0	1633.0	1101.8	494.5	207.2	29.1	
3181504CX	6	.55	270.0	5.0	243.7	196.3	127.9	63.7	19.6	
3181504CX	7	.55	270.0	5.0	234.1	192.6	129.7	63.7	19.3	
3181504CX	6	.55	270.0	20.0	204.4	162.5	102.3	52.6	15.8	
3181504CX	7	.55	270.0	20.0	262.7	200.4	130.2	70.8	21.1	
3181504CX	6	.55	270.0	40.0	105.5	84.5	58.2	33.7	10.2	
3181504CX	7	.55	270.0	40.0	401.8	270.7	215.2	123.8	40.5	
3181504CX	6	.55	270.0	60.0	199.4	154.9	90.6	42.0	11.8	
3181504CX	7	.55	270.0	60.0	1709.7	1274.8	726.3	340.9	95.6	
3181602CX	6	.55	.0	5.0	127.1	122.0	107.6	79.2	41.1	
3181602CX	7	.55	.0	5.0	129.0	122.5	107.0	78.2	41.9	
3181602CX	6	.55	.0	20.0	102.2	96.7	81.9	65.0	36.1	
3181602CX	7	.55	.0	20.0	130.4	130.8	110.1	85.3	45.2	
3181602CX	6	.55	.0	40.0	73.1	65.2	48.7	29.2	13.1	
3181602CX	7	.55	.0	40.0	287.0	256.0	193.3	116.3	47.5	
3181602CX	6	.55	.0	60.0	142.2	114.7	71.3	36.5	10.6	
3181602CX	7	.55	.0	60.0	953.5	799.3	539.2	286.8	92.9	
3181604CX	6	.55	270.0	5.0	97.6	90.1	71.5	48.6	21.6	
3181604CX	7	.55	270.0	5.0	106.0	92.7	74.2	51.4	22.8	
3181604CX	6	.55	270.0	20.0	62.3	55.3	41.4	23.9	11.5	
3181604CX	7	.55	270.0	20.0	86.6	76.3	57.2	33.3	15.0	

SAMPLE A C MFG PRIME	P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3181604CX	6	.55	270.0	40.0	36.8	33.3	27.7	21.8	14.4	
3181604CX	7	.55	270.0	40.0	156.5	142.6	111.6	78.8	34.6	
3181604CX	6	.55	270.0	60.0	45.3	40.1	28.9	18.1	12.6	
3181604CX	7	.55	270.0	60.0	460.9	402.1	269.7	127.2	38.2	
3181702CX	6	.55	.0	5.0	1.3	3.4	4.0	8.0	13.7	16.4
3181702CX	7	.55	.0	5.0	1.3	3.6	4.0	8.3	14.0	16.4
3181702CX	6	.55	.0	20.0	1.1	1.3	1.3	2.4	7.6	18.8
3181702CX	7	.55	.0	20.0	1.1	1.3	1.3	3.0	9.9	24.1
3181702CX	6	.55	.0	40.0	1.3	.7	.8	1.7	5.0	10.6
3181702CX	7	.55	.0	40.0	1.3	1.1	1.2	4.0	14.4	27.4
3181702CX	6	.55	.0	60.0	2.5	1.8	1.7	2.8	6.6	18.9
3181702CX	7	.55	0	60.0	3.6	4.0	4.2	5.5	19.8	79.0
3181704CX	6	.55	270.0	5.0	4.1	14.9	19.1	26.7	29.1	21.2
3181704CX	7	.55	270.0	5.0	4.4	15.4	19.7	26.3	31.1	22.2
3181704CX	6	.55	270.0	20.0	12.4	13.6	14.0	21.4	24.1	15.5
3181704CX	7	.55	270.0	20.0	16.0	17.9	18.6	28.9	32.6	20.3
3181704CX	6	.55	270.0	40.0	14.4	17.0	17.9	18.1	16.2	8.8
3181704CX	7	.55	270.0	40.0	52.7	61.1	64.2	67.6	61.7	25.4
3181704CX	6	.55	270.0	60.0	84.9	69.5	63.8	45.1	21.6	4.5
3181704CX	7	.55	270.0	60.0	505.9	408.5	375.0	278.3	138.8	22.3
3182403F	6	.55	180.0	5.0	131.0	128.0	125.3	109.0	69.5	25.2
3182403F	7	.55	180.0	5.0	126.8	122.0	118.5	104.7	68.1	25.2
3182403F	6	.55	180.0	20.0	262.6	259.7	254.9	215.2	134.5	53.7
3182403F	7	.55	180.0	20.0	333.0	321.8	315.9	264.9	162.2	56.5
3182403F	6	.55	180.0	40.0	65.7	61.5	59.4	49.3	31.8	17.9
3182403F	7	.55	180.0	40.0	212.9	190.9	181.3	137.6	69.0	21.2
3182403F	6	.55	180.0	60.0	136.9	113.4	105.0	74.1	42.6	24.0
3182403F	7	.55	180.0	60.0	1040.3	776.9	691.2	411.7	154.6	29.5
3182404F	6	.55	270.0	5.0	197.9	169.1	157.2	119.9	70.2	26.0
3182404F	7	.55	270.0	5.0	194.0	166.5	153.5	117.8	68.8	25.3
3182404F	6	.55	270.0	20.0	163.5	144.6	136.4	99.4	54.6	19.9
3182404F	7	.55	270.0	20.0	133.0	119.1	112.5	83.2	47.2	19.4
3182404F	6	.55	270.0	40.0	88.1	74.3	69.1	53.4	33.2	16.6
3182404F	7	.55	270.0	40.0	248.7	210.0	193.8	141.4	71.6	20.4
3182404F	6	.55	270.0	60.0	184.8	147.1	132.5	76.8	32.3	13.6
3182404F	7	.55	270.0	60.0	1087.3	832.7	736.4	386.1	115.6	13.6
3182503F	6	.55	180.0	5.0	87.2	80.9	78.6	62.5	44.5	29.6
3182503F	7	.55	180.0	5.0	86.5	80.6	78.1	61.8	43.9	29.2
3182503F	6	.55	180.0	20.0	148.0	127.4	120.0	95.6	66.8	43.3
3182503F	7	.55	180.0	20.0	185.3	157.7	147.3	116.7	80.5	50.4
3182503F	6	.55	180.0	40.0	54.9	47.4	44.5	36.7	27.6	18.4
3182503F	7	.55	180.0	40.0	84.7	100.8	107.8	89.3	61.8	35.1
3182503F	6	.55	180.0	60.0	138.8	111.3	102.1	70.6	40.1	20.2
3182503F	7	.55	180.0	60.0	865.0	688.0	628.1	417.8	202.7	47.6
3182504F	6	.55	270.0	5.0	101.6	87.9	82.5	67.8	49.1	31.8
3182504F	7	.55	270.0	5.0	101.3	87.1	81.7	66.4	47.6	30.5
3182504F	6	.55	270.0	20.0	86.4	74.5	69.8	57.9	42.6	27.8
3182504F	7	.55	270.0	20.0	104.0	87.8	82.0	68.2	49.3	30.7
3182504F	6	.55	270.0	40.0	69.8	62.9	60.4	48.2	34.1	22.1
3182504F	7	.55	270.0	40.0	175.7	159.2	152.8	116.1	74.7	37.5
3182504F	6	.55	270.0	60.0	148.1	121.2	111.8	74.4	39.5	18.6
3182504F	7	.55	270.0	60.0	812.0	664.4	611.9	386.5	165.7	33.3
3182603F	6	.55	180.0	5.0	188.0	149.8	137.6	103.6	67.5	37.9
3182603F	7	.55	180.0	5.0	172.3	152.0	140.8	103.6	66.5	38.5
3182603F	6	.55	180.0	20.0	100.5	86.6	80.5	60.6	39.2	23.3
3182603F	7	.55	180.0	20.0	134.4	110.4	101.4	75.1	47.1	25.4
3182603F	6	.55	180.0	40.0	63.5	50.3	46.5	38.4	26.8	18.5
3182603F	7	.55	180.0	40.0	208.1	177.0	162.1	116.1	65.7	28.1
3182603F	6	.55	180.0	60.0	124.1	95.0	84.4	57.1	32.7	19.1
3182603F	7	.55	180.0	60.0	996.5	731.3	643.2	404.0	179.4	33.9
3182604F	6	.55	270.0	5.0	130.8	105.4	96.1	73.7	48.7	25.9

SAMPLE	A C MFG PRIME P CODE			0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
31826C4F	7	.55270.0	5.0	130.1	106.2	97.5	74.6	49.4	25.3
31826C4F	6	.55270.0	20.0	106.6	84.5	76.5	57.1	38.3	22.3
31826C4F	7	.55270.0	20.0	140.2	109.7	98.3	72.0	46.4	24.8
3182604F	6	.55270.0	40.0	81.1	69.2	64.7	47.9	31.7	21.4
31826C4F	7	.55270.0	40.0	263.4	216.9	201.4	138.2	73.7	28.0
3182604F	6	.55270.0	60.0	197.9	143.6	126.8	75.4	36.6	20.1
3182604F	7	.55270.0	60.0	1260.7	646.2	459.2	273.5	126.2	26.9
31826C8F	6	.55280.0	9.0	123.2	107.3	101.4	72.9	45.4	24.2
31826C8F	7	.55280.0	9.0	131.0	112.9	106.5	75.9	46.6	24.2
31826C9F	6	.55 45.0	20.0	100.8	82.1	76.7	56.8	37.1	19.2
3182609F	7	.55 45.0	20.0	131.5	105.8	98.0	71.2	45.1	21.4
3182401F	2	.63100.0	5.0	77.6	211.6	221.7	155.0	32.3	
31824C1F	3	.63180.0	5.0	14.9	10.4	5.5	1.8	.6	
31824C1F	4	.63180.0	5.0	2.3	3.7	4.4	3.7	1.0	
31824C1F	5	.63180.0	5.0	484.0	314.3	149.8	42.6	14.0	
31824C1F	2	.63180.0	20.0	882.7	449.9	105.7	32.8	19.9	
31824C1F	3	.63180.0	20.0	22.4	14.8	7.0	3.0	.9	
31824C1F	4	.63180.0	20.0	41.4	20.8	6.8	2.9	1.3	
31824C1F	5	.63180.0	20.0	258.4	258.6	170.9	79.2	29.8	
31824C1F	2	.63180.0	40.0	328.1	232.9	102.7	37.7	21.5	
31824C1F	3	.63180.0	40.0	7.8	8.4	4.9	1.0	.4	
3182401F	4	.63180.0	40.0	6.6	4.5	1.6	.5	.3	
31824C1F	5	.63180.0	40.0	695.6	464.9	189.2	77.5	22.4	
31824C1F	2	.63180.0	60.0	289.0	206.1	97.8	29.2	15.9	
31824C1F	3	.63180.0	60.0	139.3	84.8	20.9	3.7	1.3	
31824C1F	4	.63180.0	60.0	15.3	12.7	7.3	2.7	1.2	
31824C1F	5	.63180.0	60.0	4224.3	2251.1	485.7	49.3	39.8	
31824C2F	2	.63270.0	5.0	793.7	316.5	74.7	18.5	8.4	
31824C2F	3	.63270.0	5.0	6.0	6.0	3.2	.7	.2	
31824C2F	4	.63270.0	5.0	35.2	15.0	2.5	.5	.3	
31824C2F	5	.63270.0	5.0	341.6	308.7	152.2	38.3	10.7	
31824C2F	2	.63270.0	20.0	571.6	312.2	108.8	22.6	8.5	
31824C2F	3	.63270.0	20.0	10.3	9.5	4.4	.7	.2	
31824C2F	4	.63270.0	20.0	45.1	21.9	6.8	1.2	.4	
3182402F	5	.63270.0	20.0	502.8	463.6	206.8	52.5	14.9	
31824C2F	2	.63270.0	40.0	320.0	270.0	105.5	22.0	12.1	
31824C2F	3	.63270.0	40.0	30.4	13.8	3.0	.7	.3	
31824C2F	4	.63270.0	40.0	16.3	16.2	9.4	1.1	.6	
3182402F	5	.63270.0	40.0	1291.1	617.7	85.8	39.1	10.8	
31824C2F	2	.63270.0	60.0	214.0	157.9	82.2	39.9	17.9	
31824C2F	3	.63270.0	60.0	91.4	73.9	31.3	5.1	.7	
3182402F	4	.63270.0	60.0	17.4	13.3	5.6	2.3	.9	
31824C2F	5	.63270.0	60.0	3290.0	2443.2	1106.8	255.9	38.4	
31825C1F	2	.63270.0	5.0	525.1	400.2	231.1	65.9	14.1	
3182501F	3	.63270.0	5.0	18.6	6.8	2.1	.6	.2	
3182501F	4	.63270.0	5.0	13.8	12.1	6.5	1.7	.3	
31825C1F	5	.63270.0	5.0	821.3	454.5	136.3	49.9	18.2	
31825C1F	2	.63270.0	20.0	732.1	445.8	150.1	43.8	13.9	
3182501F	3	.63270.0	20.0	35.0	13.0	2.7	1.2	.4	
3182501F	4	.63270.0	20.0	17.6	11.3	5.0	1.3	.3	
31825C1F	5	.63270.0	20.0	1154.2	588.2	198.9	115.0	36.0	
31825C1F	2	.63270.0	40.0	312.1	167.1	54.4	18.5	11.8	
3182501F	3	.63270.0	40.0	22.6	10.5	2.8	.6	.2	
31825C1F	4	.63270.0	40.0	14.8	15.2	5.5	1.6	.6	
31825C1F	5	.63270.0	40.0	1526.2	841.6	214.5	60.1	27.7	
31825C1F	2	.63270.0	60.0	354.4	205.1	81.9	31.8	17.5	
3182501F	3	.63270.0	60.0	57.2	40.7	11.3	3.7	.8	
31825C1F	4	.63270.0	60.0	21.4	11.1	3.5	1.2	.6	
31825C1F	5	.63270.0	60.0	1959.5	1996.6	857.2	134.0	26.0	
31825C2F	2	.63180.0	5.0	676.6	274.0	96.9	61.8	21.8	
3182502F	3	.63180.0	5.0	11.0	4.3	1.5	1.2	.4	

SAMPLE	A C MFG PRIME P CODE			0^0-.1^0	.1^0-.2^0	.2^0-.3^0	.3^0-.4^0	.4^0-.7^0	.7^0-1.0^0
3182502H	4	.63180.0	5.0	16.4	6.0	2.2	1.4	.5	
3182502H	5	.63180.0	5.0	715.7	314.1	80.9	39.6	23.2	
3182502H	2	.63180.0	20.0	430.3	262.2	146.5	86.1	22.4	
3182502H	3	.63180.0	20.0	9.7	6.0	3.2	1.9	.5	
3182502H	4	.63180.0	20.0	14.2	11.5	8.1	2.7	1.5	
3182502H	5	.63180.0	20.0	436.6	308.1	169.0	88.5	18.7	
3182502H	2	.63180.0	40.0	184.0	126.4	71.5	49.4	25.7	
3182502H	3	.63180.0	40.0	18.7	8.6	5.3	4.1	1.0	
3182502H	4	.63180.0	40.0	5.5	3.8	2.3	1.6	.8	
3182502H	5	.63180.0	40.0	865.7	365.0	185.4	133.8	44.9	
3182502H	2	.63180.0	60.0	120.6	90.8	57.6	41.5	24.6	
3182502H	3	.63180.0	60.0	43.9	23.2	10.4	10.1	2.6	
3182502H	4	.63180.0	60.0	4.7	3.4	2.2	1.7	1.0	
3182502H	5	.63180.0	60.0	1643.4	1136.5	633.9	427.1	115.8	
3182601H	2	.63180.0	5.0	613.4	240.2	54.8	17.8	9.4	
3182601H	3	.63180.0	5.0	10.7	7.4	2.7	.7	.4	
3182601H	4	.63180.0	5.0	12.3	4.6	1.1	.4	.2	
3182601H	5	.63180.0	5.0	543.1	301.8	104.8	29.8	15.7	
3182601H	2	.63180.0	20.0	430.0	281.8	74.2	18.0	10.8	
3182601H	3	.63180.0	20.0	13.4	6.2	2.4	1.1	.2	
3182601H	4	.63180.0	20.0	8.5	5.0	1.3	.4	.2	
3182601H	5	.63180.0	20.0	808.3	390.0	140.4	36.3	10.4	
3182601H	2	.63180.0	40.0	198.5	135.5	64.8	29.0	16.5	
3182601H	3	.63180.0	40.0	28.9	18.5	9.5	3.9	1.4	
3182601H	4	.63150.0	40.0	3.6	3.1	1.7	.7	.5	
3182601H	5	.63180.0	40.0	1012.6	688.8	307.4	130.7	44.5	
3182601H	2	.63180.0	60.0	217.4	118.4	77.4	51.2	25.7	
3182601H	3	.63180.0	60.0	125.4	82.1	36.9	26.3	6.6	
3182601H	4	.63180.0	60.0	12.4	7.0	3.7	2.8	1.5	
3182601H	5	.63180.0	60.0	2493.8	1474.8	740.0	487.6	136.5	
3182602H	2	.63270.0	5.0	1236.7	408.1	62.6	20.1	15.4	
3182602H	3	.63270.0	5.0	16.3	5.[illegible]	.6	.3	.3	
3182602H	4	.63270.0	5.0	35.3	10.8	1.2	.4	.4	
3182602H	5	.63270.0	5.0	758.3	323.2	42.3	47.4	126.1	
3182602H	2	.63270.0	20.0	875.1	872.4	310.0	51.7	25.5	
3182602H	3	.63270.0	20.0	12.1	5.3	1.6	.4	.3	
3182602H	4	.63270.0	20.0	16.1	7.8	2.0	.5	.4	
3182602H	5	.63270.0	20.0	724.8	322.5	87.1	19.6	13.5	
3182602H	2	.63270.0	40.0	376.2	218.5	72.5	21.9	17.4	
3182602H	3	.63270.0	40.0	28.7	11.7	1.5	.4	.3	
3182602H	4	.63270.0	40.0	10.0	4.8	1.4	.5	.4	
3182602H	5	.63270.0	40.0	1570.7	770.3	103.5	25.7	17.7	
3182602H	2	.63270.0	60.0	526.7	260.2	71.3	21.2	18.2	
3182602H	3	.63270.0	60.0	118.2	63.0	12.4	1.3	.4	
3182602H	4	.63270.0	60.0	14.2	5.7	1.4	.6	.4	
3182602H	5	.63270.0	60.0	1729.2	1480.3	513.9	68.1	22.2	
3182406H	2	1.06270.0	5.0	612.1	442.9	225.9	111.8	48.4	
3182406H	3	1.06270.0	5.0	7.0	4.1	1.4	.9	1.4	
3182406H	4	1.06270.0	5.0	2.4	2.1	1.4	.8	.4	
3182406H	5	1.06270.0	5.0	604.9	361.9	119.1	45.9	24.1	
3182406H	2	1.06270.0	20.0	578.8	243.3	102.8	50.1	33.8	
3182406H	3	1.06270.0	20.0	4.7	2.6	.9	.4	.3	
3182406H	4	1.06270.0	20.0	2.0	1.1	.5	.4	.3	
3182406H	5	1.06270.0	20.0	453.3	257.3	87.5	34.4	20.7	
3182406H	2	1.06270.0	40.0	204.1	185.[illegible]	93.4	45.6	28.9	
3182406H	3	1.06270.0	40.0	19.6	10.2	3.5	1.1	.5	
3182406H	4	1.06270.0	40.0	1.8	14.5	30.3	9.5	4.1	
3182406H	5	1.06270.0	40.0	1357.9	790.3	287.5	84.1	35.3	
3182406H	2	1.06270.0	60.0	95.5	112.8	119.7	74.8	33.6	
3182406H	3	1.06270.0	60.0	70.8	55.1	26.3	7.7	1.2	
3182406H	4	1.06270.0	60.0	5.8	8.3	8.4	4.6	1.3	

SAMPLE A/C MFG PRIME	P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3182406H	5	1.06	270.0	60.0	4753.5	3268.0	1431.5	429.6	85.0	
3182407H	2	1.06	.0	5.0	224.6	157.5	111.8	71.2	32.8	
3182407H	3	1.06	.0	5.0	2.0	1.7	.8	.4	.3	
3182407H	4	1.06	.0	5.0	1.5	1.2	.9	.7	.4	
3182407H	5	1.06	.0	5.0	141.2	127.8	64.9	22.0	10.6	
3182407H	2	1.06	.0	20.0	493.5	295.8	104.1	40.2	16.6	
3182407H	3	1.06	.0	20.0	3.4	2.6	1.8	1.0	.5	
3182407H	4	1.06	.0	20.0	2.8	1.9	.8	.4	.4	
3182407H	5	1.06	.0	20.0	198.1	162.0	119.6	74.1	36.5	
3182407H	2	1.06	.0	40.0	105.1	69.0	45.5	44.2	29.1	
3182407H	3	1.06	.0	40.0	10.1	8.6	4.7	2.7	1.1	
3182407H	4	1.06	.0	40.0	.8	.7	.7	.8	.5	
3182407H	5	1.06	.0	40.0	438.6	386.1	252.3	159.6	59.7	
3182407H	2	1.06	.0	60.0	32.2	57.9	51.7	34.6	45.8	
3182407H	3	1.06	.0	60.0	75.5	65.5	37.6	22.2	16.3	
3182407H	4	1.06	.0	60.0	1.2	3.1	3.6	2.4	1.9	
3182407H	5	1.06	.0	60.0	2545.1	2366.5	1320.3	757.6	384.3	
3182506H	2	1.06	270.0	5.0	184.5	184.5	74.7	24.9	15.3	
3182506H	3	1.06	270.0	5.0	1.4	1.0	.4	.3	.2	
3182506H	4	1.06	270.0	5.0	2.6	2.5	1.0	.4	.3	
3182506H	5	1.06	270.0	5.0	187.3	142.9	58.8	32.8	27.4	
3182506H	2	1.06	270.0	20.0	422.8	222.2	97.7	32.1	17.5	
3182506H	3	1.06	270.0	20.0	2.1	2.0	1.4	.6	.3	
3182506H	4	1.06	270.0	20.0	2.1	1.2	.7	.3	.3	
3182506H	5	1.06	270.0	20.0	494.0	392.5	198.3	72.0	29.2	
3182506H	2	1.06	270.0	40.0	230.4	125.4	58.8	29.8	22.2	
3182506H	3	1.06	270.0	40.0	6.5	5.1	3.0	1.4	.5	
3182506H	4	1.06	270.0	40.0	2.3	1.4	.7	.4	.4	
3182506H	5	1.06	270.0	40.0	534.1	413.3	245.1	106.3	37.5	
3182506H	2	1.06	270.0	60.0	690.2	373.1	137.5	69.3	27.0	
3182506H	3	1.06	270.0	60.0	58.1	42.4	15.3	3.6	1.2	
3182506H	4	1.06	270.0	60.0	28.4	14.3	4.6	1.9	.7	
3182506H	5	1.06	270.0	60.0	3250.9	2324.3	867.4	216.2	64.0	
3182507H	2	1.06	.0	5.0	137.6	129.2	102.0	65.9	35.9	
3182507H	3	1.06	.0	5.0	6.4	5.3	2.7	1.2	.6	
3182507H	4	1.06	.0	5.0	2.0	1.8	1.3	.8	.5	
3182507H	5	1.06	.0	5.0	292.0	255.0	141.2	57.4	27.2	
3182507H	2	1.06	.0	20.0	83.5	75.4	49.3	34.7	24.9	
3182507H	3	1.06	.0	20.0	4.7	4.2	2.5	1.2	.7	
3182507H	4	1.06	.0	20.0	1.0	.8	.7	.6	.5	
3182507H	5	1.06	.0	20.0	229.3	205.7	126.6	62.0	28.4	
3182507H	2	1.06	.0	40.0	92.3	104.8	82.5	53.1	23.8	
3182507H	3	1.06	.0	40.0	9.3	11.6	9.8	5.2	2.7	
3182507H	4	1.06	.0	40.0	1.1	1.4	1.2	.9	.6	
3182507H	5	1.06	.0	40.0	517.8	588.2	455.4	322.4	143.9	
3182507H	2	1.06	.0	60.0	42.9	54.4	43.1	30.9	17.3	
3182507H	3	1.06	.0	60.0	13.1	12.3	8.9	6.5	2.6	
3182507H	4	1.06	.0	60.0	4.2	4.9	4.4	3.0	1.6	
3182507H	5	1.06	.0	60.0	541.1	554.4	447.4	334.3	140.9	
3182606H	2	1.06	270.0	5.0	641.7	203.2	111.3	37.9	23.2	
3182606H	3	1.06	270.0	5.0	4.1	6.4	2.8	.8	.5	
3182606H	4	1.06	270.0	5.0	11.7	4.9	2.0	.8	.5	
3182606H	5	1.06	270.0	5.0	246.7	306.3	169.6	44.7	21.9	
3182606H	2	1.06	270.0	20.0	501.0	413.9	121.8	37.3	23.2	
3182606H	3	1.06	270.0	20.0	20.7	13.0	4.3	1.1	.7	
3182606H	4	1.06	270.0	20.0	6.1	5.4	1.7	.6	.5	
3182606H	5	1.06	270.0	20.0	1350.5	818.9	255.0	66.2	31.6	
3182606H	2	1.06	270.0	40.0	470.6	287.8	58.2	24.5	22.4	
3182606H	3	1.06	270.0	40.0	45.5	26.7	5.0	1.3	.9	
3182606H	4	1.06	270.0	40.0	7.3	4.7	1.1	.5	.6	
3182606H	5	1.06	270.0	40.0	2334.2	1303.7	257.5	64.5	40.4	

SAMPLE	A.C MFG PRIME P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3182606H	2	1.06	270.0	60.0	306.6	298.6	151.4	59.7	30.4	
3182606H	3	1.06	270.0	60.0	243.5	201.3	76.3	11.4	2.3	
3182606H	4	1.06	270.0	60.0	50.3	36.7	12.5	3.8	1.5	
3182606H	5	1.06	270.0	60.0	12088.8	8989.6	3467.2	517.4	109.7	
3182607H	2	1.06	.0	5.0	449.5	300.9	114.1	41.6	22.0	
3182607H	3	1.06	.0	5.0	5.2	2.5	1.1	.4	.2	
3182607H	4	1.06	.0	5.0	3.9	2.5	1.0	.4	.3	
3182607H	5	1.06	.0	5.0	505.9	220.3	97.8	31.0	18.4	
3182607H	2	1.06	.0	20.0	328.7	177.5	79.2	27.8	17.0	
3182607H	3	1.06	.0	20.0	7.1	3.1	1.4	.6	.3	
3182607H	4	1.06	.0	20.0	3.6	1.9	.8	.3	.2	
3182607H	5	1.06	.0	20.0	6[illegible]8.0	292.3	113.4	41.7	20.2	
3182607H	2	1.06	.0	40.0	112.9	12[illegible].3	88.9	32.7	10.9	
3182607H	3	1.06	.0	40.0	22.0	16.1	7.2	1.9	.5	
3182607H	4	1.06	.0	40.0	1.2	1.3	1.0	.5	.4	
3182607H	5	1.06	.0	[illegible]	1218.4	818.0	325.4	87.6	21.6	
3182607H	2	1.06	.0	60.0	125.7	101.3	66.7	36.5	22.4	
3182607H	3	1.06	.0	60.0	64.4	43.2	24.8	10.5	2.6	
3182607H	4	1.06	.0	60.0	17.0	11.8	5.7	2.2	.8	
3182607H	5	1.06	.0	60.0	2925.8	1604.4	874.8	355.8	104.8	
3183501H	6	.55	.0	5.0	197.1	182.3	153.2	114.9	57.3	
3183501H	7	.55	.0	5.0	186.3	172.0	147.3	111.9	53.8	
3183501H	6	.55	.0	20.0	136.4	129.9	107.1	83.9	47.5	
3183501H	7	.55	.0	20.0	162.9	152.5	124.3	96.2	52.8	
3183501H	6	.55	.0	40.0	107.5	97.5	77.6	53.7	26.3	
3183501H	7	.55	.0	40.0	299.9	264.1	207.9	135.2	51.5	
3183501H	6	.55	.0	60.0	239.3	203.5	148.0	86.2	30.7	
3183501H	7	.55	.0	60.0	1061.5	898.8	648.1	349.9	98.8	
3183502H	6	.55	270.0	5.0	148.9	129.9	101.6	74.0	50.3	
3183502H	7	.55	270.0	5.0	150.9	129.4	100.1	72.8	49.7	
3183502H	6	.55	270.0	20.0	139.2	126.5	98.5	67.2	39.6	
3183502H	7	.55	270.0	20.0	177.0	159.3	124.9	86.4	50.0	
3183502H	6	.55	270.0	40.0	87.6	73.3	51.8	34.8	20.4	
3183502H	7	.55	270.0	40.0	281.3	231.9	159.7	108.8	59.8	
3183502H	6	.55	270.0	60.0	175.0	135.4	84.0	42.0	17.0	
3183502H	7	.55	270.0	60.0	1190.9	925.7	549.1	254.8	74.4	
3183601H	6	.55	.0	5.0	84.1	81.1	79.4	66.6	41.4	10.9
3183601H	7	.55	.0	5.0	80.6	79.1	77.8	68.5	41.6	10.0
3183601H	6	.55	.0	20.0	98.1	82.4	77.8	53.6	26.6	5.6
3183601H	7	.55	.0	20.0	119.6	105.8	100.6	67.3	32.1	6.7
3183601H	6	.55	.0	40.0	72.8	51.2	45.6	26.0	11.4	2.9
3183601H	7	.55	.0	40.0	192.7	155.5	142.9	88.4	39.1	6.9
3183601H	6	.55	.0	60.0	116.1	98.1	89.3	43.5	12.5	3.1
3183601H	7	.55	.0	60.0	688.8	544.5	497.5	268.3	90.5	18.0
3183602H	6	.55	270.0	5.0	75.2	75.1	75.3	63.3	40.7	13.6
3183602H	7	.55	270.0	5.0	81.3	80.8	80.8	66.6	40.9	12.5
3183602H	6	.55	270.0	20.0	89.2	81.6	78.5	59.3	32.6	9.3
3183602H	7	.55	270.0	20.0	109.9	106.1	103.5	79.2	43.4	11.2
3183602H	6	.55	270.0	40.0	60.3	49.3	45.3	30.5	13.9	3.4
3183602H	7	.55	270.0	40.0	245.4	204.2	187.4	122.8	51.8	7.9
3183602H	6	.55	270.0	60.0	88.5	78.0	73.6	43.5	14.3	1.2
3183602H	7	.55	270.0	60.0	835.8	705.1	660.5	393.7	139.6	15.7
3183701H	6	.55	.0	5.0	324.4	250.7	132.4	58.6	23.1	
3183701H	7	.55	.0	5.0	328.4	251.5	130.4	57.9	22.7	
3183701H	6	.55	.0	20.0	290.2	198.6	100.8	45.6	19.9	
3183701H	7	.55	.0	20.0	375.3	247.1	125.9	56.0	22.9	
3183701H	6	.55	.0	40.0	178.6	130.3	76.0	39.7	16.2	
3183701H	7	.55	.0	40.0	537.9	384.2	217.1	107.6	31.8	
3183701H	6	.55	.0	60.0	260.7	180.0	76.6	28.0	11.3	
3183701H	7	.55	.0	60.0	1197.4	833.6	352.8	116.3	32.2	
3183702H	6	.55	270.0	5.0	323.4	262.5	167.7	88.7	28.6	

SAMPLE	A C	MFG	PRIME	P CODE	λ	φ	θ	0^{o}-$.1^{o}$	$.1^{o}$-$.2^{o}$	$.2^{o}$-$.3^{o}$	$.3^{o}$-$.4^{o}$	$.4^{o}$-$.7^{o}$	$.7^{o}$-1.0^{o}
3183702F				7	.55	270.0	5.0	332.3	265.3	163.0	86.0	29.8	
3183702F				6	.55	270.0	20.0	299.4	234.5	135.1	65.3	23.6	
3183702F				7	.55	270.0	20.0	357.2	282.0	173.2	86.1	29.5	
3183702F				6	.55	270.0	40.0	158.2	129.4	84.4	40.3	15.5	
3183702F				7	.55	270.0	40.0	445.2	364.5	237.7	117.2	32.6	
3183702F				6	.55	270.0	60.0	228.3	176.5	109.6	53.9	19.5	
3183702F				7	.55	270.0	60.0	1185.1	961.9	594.2	254.7	72.0	
3184406C				6	.55	180.0	5.0	855.1	633.0	322.1	133.7	31.7	
3184406C				7	.55	180.0	5.0	878.1	626.3	321.5	145.7	33.8	
3184406C				6	.55	180.0	20.0	662.7	489.5	250.0	112.0	30.2	
3184406C				7	.55	180.0	20.0	697.9	488.7	263.3	114.9	31.7	
3184406C				6	.55	180.0	40.0	217.7	201.9	172.4	110.9	40.6	
3184406C				7	.55	180.0	40.0	225.2	216.4	171.8	120.4	52.0	
3184406C				6	.55	180.0	60.0	506.7	421.1	324.7	210.9	69.2	
3184406C				7	.55	180.0	60.0	527.3	439.5	326.0	198.6	70.2	
3184408C				6	.55	270.0	5.0	801.8	626.6	353.1	140.2	28.9	
3184408C				7	.55	270.0	5.0	833.0	647.1	357.1	141.0	29.1	
3184408C				6	.55	270.0	20.0	907.7	662.6	307.7	127.0	24.8	
3184408C				7	.55	270.0	20.0	936.9	680.5	317.0	132.3	26.6	
3184408C				6	.55	270.0	40.0	902.3	718.3	393.7	133.4	28.8	
3184408C				7	.55	270.0	40.0	970.8	761.8	422.7	140.5	28.7	
3184408C				6	.55	270.0	60.0	221.6	167.5	113.2	58.5	15.5	
3184408C				7	.55	270.0	60.0	1405.1	1090.3	753.8	395.2	88.3	
3184506C				6	.55	270.0	5.0	262.9	228.5	157.8	94.4	28.3	
3184506C				7	.55	270.0	5.0	251.3	221.2	155.1	94.0	28.6	
3184506C				6	.55	270.0	20.0	246.3	218.2	166.2	113.2	62.1	
3184506C				7	.55	270.0	20.0	266.1	221.5	162.9	117.5	64.2	
3184506C				6	.55	270.0	40.0	95.0	140.0	151.2	138.7	100.5	
3184506C				7	.55	270.0	40.0	96.2	145.0	155.4	140.0	98.9	
3184506C				6	.55	270.0	60.0	160.2	137.1	98.4	56.7	24.3	
3184506C				7	.55	270.0	60.0	1125.1	935.6	654.8	369.5	129.4	
3184508C				6	.55	180.0	5.0	448.0	350.3	205.0	105.3	54.6	
3184508C				7	.55	180.0	5.0	396.2	279.0	176.2	92.1	51.3	
3184508C				6	.55	180.0	20.0	173.7	171.7	172.8	138.3	74.9	
3184508C				7	.55	180.0	20.0	174.1	171.4	173.9	140.7	79.6	
3184508C				6	.55	180.0	40.0	518.2	415.0	259.2	139.9	63.4	
3184508C				7	.55	180.0	40.0	507.0	408.4	268.4	163.9	100.8	
3184508C				6	.55	180.0	60.0	40.1	42.0	42.3	35.5	25.5	
3184508C				7	.55	180.0	60.0	362.7	362.3	326.6	265.6	175.8	
3184606C				6	.55	180.0	5.0	333.3	308.9	263.0	194.5	112.0	
3184606C				7	.55	180.0	5.0	304.3	292.6	251.7	190.5	108.4	
3184606C				6	.55	180.0	20.0	446.0	382.4	289.7	205.5	105.4	
3184606C				7	.55	180.0	20.0	453.6	391.0	294.5	206.1	105.2	
3184606C				6	.55	180.0	40.0	426.0	400.2	315.8	215.0	117.3	
3184606C				7	.55	180.0	40.0	491.3	443.9	345.9	231.2	121.2	
3184606C				6	.55	180.0	60.0	418.4	366.8	274.5	193.1	96.2	
3184606C				7	.55	180.0	60.0	430.5	372.2	281.3	186.5	89.6	
3184608C				6	.55	270.0	5.0	387.9	344.6	262.0	179.6	92.9	
3184608C				7	.55	270.0	5.0	395.5	350.2	265.8	184.1	95.0	
3184608C				6	.55	270.0	20.0	477.1	420.1	291.9	187.3	90.0	
3184608C				7	.55	270.0	20.0	504.5	444.4	311.0	198.8	95.4	
3184608C				6	.55	270.0	40.0	344.9	313.3	219.2	154.0	90.5	
3184608C				7	.55	270.0	40.0	382.3	354.3	246.2	172.1	102.7	
3184608C				6	.55	270.0	60.0	428.9	365.5	228.6	134.7	58.3	
3184608C				7	.55	270.0	60.0	426.7	359.7	232.4	139.9	63.8	
3184405CX				6	.55	180.0	5.0	228.8	208.5	166.2	111.6	47.1	
3184405CX				7	.55	180.0	5.0	211.6	186.0	145.7	94.4	46.2	
3184405CX				6	.55	180.0	20.0	188.4	181.0	143.0	96.0	37.6	
3184405CX				7	.55	180.0	20.0	262.6	236.1	186.1	123.4	47.5	
3184405CX				6	.55	180.0	40.0	125.1	100.4	70.6	45.2	15.7	
3184405CX				7	.55	180.0	40.0	357.5	292.2	208.9	131.7	44.7	

SAMPLE A/C MFG PRIME	P CODE	λ	φ	θ	$0^{\circ}-.1^{\circ}$	$.1^{\circ}-.2^{\circ}$	$.2^{\circ}-.3^{\circ}$	$.3^{\circ}-.4^{\circ}$	$.4^{\circ}-.7^{\circ}$	$.7^{\circ}-1.0^{\circ}$
3184405CX	6	.55	180.0	60.0	228.0	179.9	112.7	55.6	16.7	
3184405CX	7	.55	180.0	60.0	1540.1	1201.5	745.6	376.0	97.5	
3184407CX	6	.55	270.0	5.0	306.1	259.1	186.5	112.8	48.8	
3184407CX	7	.55	270.0	5.0	310.4	261.2	189.1	115.5	51.3	
3184407CX	6	.55	270.0	20.0	266.0	229.7	161.5	86.9	32.0	
3184407CX	7	.55	270.0	20.0	342.1	287.4	203.7	111.4	40.8	
3184407CX	6	.55	270.0	40.0	142.5	111.9	72.5	45.4	18.6	
3184407CX	7	.55	270.0	40.0	447.8	362.6	238.8	151.4	52.6	
3184407CX	6	.55	270.0	60.0	182.8	166.3	100.4	46.4	15.0	
3184407CX	7	.55	270.0	60.0	1280.9	1041.8	676.0	321.0	111.0	
3184505CX	6	.55	270.0	5.0	96.2	91.8	81.5	70.7	62.1	
3184505CX	7	.55	270.0	5.0	103.8	98.9	88.8	76.1	66.4	
3184505CX	6	.55	270.0	20.0	82.5	76.7	67.5	55.7	49.4	
3184505CX	7	.55	270.0	20.0	114.1	106.7	95.5	79.1	67.1	
3184505CX	6	.55	270.0	40.0	53.0	53.7	46.6	36.6	24.8	
3184505CX	7	.55	270.0	40.0	200.3	201.7	173.2	136.7	70.7	
3184505CX	6	.55	270.0	60.0	140.2	114.1	80.4	51.6	18.8	
3184505CX	7	.55	270.0	60.0	1008.8	806.6	564.8	340.7	114.0	
3184507CX	6	.55	180.0	5.0	116.9	107.3	89.6	69.8	41.4	
3184507CX	7	.55	180.0	5.0	115.0	105.1	88.0	68.5	40.9	
3184507CX	6	.55	180.0	20.0	96.2	89.3	73.4	57.3	41.9	
3184507CX	7	.55	180.0	20.0	127.2	116.9	95.0	72.5	50.0	
3184507CX	6	.55	180.0	40.0	56.7	49.7	38.4	28.5	14.0	
3184507CX	7	.55	180.0	40.0	213.5	185.5	142.4	103.0	43.9	
3184507CX	6	.55	180.0	60.0	129.6	112.9	89.2	68.8	37.5	
3184507CX	7	.55	180.0	60.0	909.6	774.5	587.1	402.9	139.6	
3184605CX	6	.55	180.0	5.0	565.2	389.7	173.8	49.2	10.3	
3184605CX	7	.55	180.0	5.0	550.1	379.2	163.5	46.1	9.8	
3184605CX	6	.55	180.0	20.0	435.0	312.7	121.7	36.2	7.4	
3184605CX	7	.55	180.0	20.0	588.8	380.4	144.9	42.2	8.1	
3184605CX	6	.55	180.0	40.0	241.7	170.3	89.7	27.5	7.9	
3184605CX	7	.55	180.0	40.0	781.2	553.4	272.5	70.1	14.8	
3184605CX	6	.55	180.0	60.0	315.2	239.4	118.4	42.3	10.7	
3184605CX	7	.55	180.0	60.0	1592.1	1263.7	598.9	195.9	50.4	
3184607CX	6	.55	270.0	5.0	239.0	201.4	131.6	49.6	9.9	
3184607CX	7	.55	270.0	5.0	269.6	219.5	133.9	51.0	9.8	
3184607CX	6	.55	270.0	20.0	334.8	252.7	135.6	58.9	14.2	
3184607CX	7	.55	270.0	20.0	448.9	340.6	198.1	77.5	16.9	
3184607CX	6	.55	270.0	40.0	175.0	126.7	65.1	20.7	5.2	
3184607CX	7	.55	270.0	40.0	598.6	444.5	217.0	72.6	18.3	
3184607CX	6	.55	270.0	60.0	194.5	147.3	69.1	31.1	8.7	
3184607CX	7	.55	270.0	60.0	1277.5	824.5	436.8	217.6	70.2	
3184401C	2	.63	180.0	5.0	505.3	406.7	172.9	26.4	4.2	
3184401C	3	.63	180.0	5.0	23.2	8.1	1.8	.2	.1	
3184401C	4	.63	180.0	5.0	24.7	19.8	7.9	.9	.2	
3184401C	5	.63	180.0	5.0	855.0	297.2	54.5	3.5	1.0	
3184401C	2	.63	180.0	20.0	66.6	130.7	102.3	23.4	2.0	
3184401C	3	.63	180.0	20.0	21.7	11.9	3.5	.2	.1	
3184401C	4	.63	180.0	20.0	14.0	11.1	5.1	1.5	.2	
3184401C	5	.63	180.0	20.0	734.6	398.5	110.4	7.2	2.0	
3184401C	2	.63	180.0	40.0	183.3	156.7	87.0	33.9	3.5	
3184401C	3	.63	180.0	40.0	42.3	18.3	4.5	1.3	.9	
3184401C	4	.63	180.0	40.0	10.3	7.6	4.1	1.8	.2	
3184401C	5	.63	180.0	40.0	1374.6	950.1	551.8	20.5	8.7	
3184401C	2	.63	180.0	60.0	245.3	137.3	64.4	28.0	5.9	
3184401C	3	.63	180.0	60.0	130.0	72.6	28.1	6.8	1.0	
3184401C	4	.63	180.0	60.0	56.4	25.3	4.6	1.6	.6	
3184401C	5	.63	180.0	60.0	3701.6	1981.7	646.1	189.2	10.5	
3184404C	2	.63	270.0	5.0	357.7	317.6	58.9	20.5	5.3	
3184404C	3	.63	270.0	5.0	35.4	18.5	4.1	.7	.2	
3184404C	4	.63	270.0	5.0	20.4	16.5	2.3	.8	.3	

SAMPLE / A C / MFG / PRIME	P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
31844C4C	5	.6327	0.0	5.0	1010.5	290.8	85.8	23.2	5.9	
31844C4C	2	.6327	0.0	20.0	703.3	185.8	85.5	65.1	52.6	
31844C4C	3	.6327	0.0	20.0	41.4	10.6	2.3	.6	.2	
31844C4C	4	.6327	0.0	20.0	58.9	24.3	2.3	.5	.2	
31844C4C	5	.6327	0.0	20.0	1275.4	304.9	93.5	22.1	5.9	
31844C4C	2	.6327	0.0	40.0	1151.5	545.6	144.3	30.7	6.6	
31844C4C	3	.6327	0.0	40.0	38.5	11.4	3.5	.9	.3	
31844C4C	4	.6327	0.0	40.0	75.1	39.0	7.8	1.2	.3	
31844C4C	5	.6327	0.0	40.0	1097.2	357.4	100.5	26.1	6.7	
31844C4C	2	.6327	0.0	60.0	826.7	748.5	470.9	161.9	8.3	
31844C4C	3	.6327	0.0	60.0	143.9	56.4	6.2	2.5	.8	
31844C4C	4	.6327	0.0	60.0	42.2	49.3	35.0	11.0	.6	
31844C4C	5	.6327	0.0	60.0	2057.3	916.7	126.5	52.3	16.6	
31845C2C	2	.6327	0.0	5.0	1529.7	505.2	45.7	6.6	7.3	
31845C2C	3	.6327	0.0	5.0	28.8	26.1	9.0	1.3	.2	
31845C2C	4	.6327	0.0	5.0	56.9	19.1	2.8	.5	.4	
31845C2C	5	.6327	0.0	5.0	827.8	625.4	188.4	20.7	2.6	
31845C2C	2	.6327	0.0	20.0	1467.5	412.3	67.6	8.5	3.3	
31845C2C	3	.6327	0.0	20.0	57.2	35.9	8.2	.2	.2	
31845C2C	4	.6327	0.0	20.0	51.4	19.2	4.4	.6	.3	
31845C2C	5	.6327	0.0	20.0	1394.2	934.7	203.0	4.3	2.2	
31845C2C	2	.6327	0.0	40.0	2192.9	1117.6	293.5	42.3	1.8	
31845C2C	3	.6327	0.0	40.0	60.7	41.7	17.7	1.8	.3	
31845C2C	4	.6327	0.0	40.0	122.7	67.3	23.3	4.4	.4	
31845C2C	5	.6327	0.0	40.0	1248.7	813.9	314.5	32.4	6.1	
31845C2C	2	.6327	0.0	60.0	1131.3	889.3	574.7	232.9	43.8	
31845C2C	3	.6327	0.0	60.0	47.9	39.7	24.1	10.2	3.7	
31845C2C	4	.6327	0.0	60.0	82.4	63.3	34.6	12.8	2.7	
31845C2C	5	.6327	0.0	60.0	973.4	826.1	446.0	217.9	70.0	
31846C2C	2	.6318	0.0	5.0	412.7	560.8	164.9	6.4	2.1	
31846C2C	3	.6318	0.0	5.0	32.9	19.9	4.3	.5	.1	
31846C2C	4	.6318	0.0	5.0	13.2	18.7	7.1	.5	.2	
31846C2C	5	.6318	0.0	5.0	1313.1	730.0	135.9	14.1	2.9	
31846C2C	2	.6318	0.0	20.0	620.6	623.0	95.1	5.9	2.9	
31846C2C	3	.6318	0.0	20.0	40.0	18.0	3.2	.4	.2	
31846C2C	4	.6318	0.0	20.0	154.5	97.6	13.7	1.5	.5	
31846C2C	5	.6318	0.0	20.0	1663.6	668.1	83.5	7.1	3.4	
31846C2C	2	.6318	0.0	40.0	1549.7	504.6	204.2	11.1	6.7	
31846C2C	3	.6318	0.0	40.0	32.1	31.7	10.0	1.4	.2	
31846C2C	4	.6318	0.0	40.0	60.2	38.0	8.6	.4	.4	
31846C2C	5	.6318	0.0	40.0	515.8	521.0	79.1	22.9	3.7	
31846C2C	2	.6318	0.0	60.0	2383.0	1390.0	485.0	108.2	8.9	
31846C2C	3	.6318	0.0	60.0	99.8	62.4	23.9	9.0	1.4	
31846C2C	4	.6318	0.0	60.0	117.5	68.7	25.4	6.2	.7	
31846C2C	5	.6318	0.0	60.0	2285.0	1385.1	497.3	178.6	23.4	
31847C2C	2	.6318	0.0	5.0	1932.4	811.6	83.3	15.9	5.7	
31847C2C	3	.6318	0.0	5.0	34.6	16.2	3.7	.5	.2	
31847C2C	4	.6316	0.0	5.0	49.2	19.8	2.2	.6	.3	
31847C2C	5	.6318	0.0	5.0	1315.1	574.4	131.3	21.4	7.9	
31847C2C	2	.6318	0.0	20.0	1843.2	893.7	175.0	21.4	7.1	
31847C2C	3	.6318	0.0	20.0	39.2	19.0	3.9	.6	.2	
31847C2C	4	.6318	0.0	20.0	51.5	23.6	4.1	.6	.2	
31847C2C	5	.6318	0.0	20.0	1744.5	703.0	123.2	21.1	7.7	
31847C2C	2	.6318	0.0	40.0	2275.5	1141.0	202.4	35.7	10.1	
31847C2C	3	.6318	0.0	40.0	50.9	27.1	7.5	1.0	.4	
31847C2C	4	.6318	0.0	40.0	68.6	35.5	6.8	1.1	.2	
31847C2C	5	.6318	0.0	40.0	1727.5	895.2	260.4	32.9	9.5	
31847C2C	2	.6318	0.0	60.0	1658.9	965.4	557.7	255.4	47.9	
31847C2C	3	.6318	0.0	60.0	63.6	38.4	20.7	7.1	1.7	
31847C2C	4	.6318	0.0	60.0	99.4	56.7	32.3	13.8	2.4	
31847C2C	5	.6318	0.0	60.0	1033.7	631.7	351.6	128.6	26.5	

SAMPLE A/C MFG PRIME	P CODE	λ φ	θ	0^{o}-$.1^{o}$	$.1^{o}$-$.2^{o}$	$.2^{o}$-$.3^{o}$	$.3^{o}$-$.4^{o}$	$.4^{o}$-$.7^{o}$	$.7^{o}$-1.0^{o}
3184704C	2	.63270.0	5.0	605.7	518.1	218.9	58.0	7.3	
3184704C	3	.63270.0	5.0	5.1	12.0	10.1	4.0	.7	
3184704C	4	.63270.0	5.0	19.4	21.1	10.5	3.1	.4	
3184704C	5	.63270.0	5.0	317.2	580.6	392.7	135.6	24.7	
3184704C	2	.63270.0	20.0	1043.4	739.5	243.5	47.7	6.1	
3184704C	3	.63270.0	20.0	28.4	20.2	5.6	.9	.2	
3184704C	4	.63270.0	20.0	36.0	26.6	9.8	2.1	.3	
3184704C	5	.63270.0	20.0	1421.1	872.2	168.9	27.4	5.1	
3184704C	2	.63270.0	40.0	1844.5	882.4	306.9	114.1	7.4	
3184704C	3	.63270.0	40.0	62.1	28.2	8.3	2.8	.4	
3184704C	4	.63270.0	40.0	72.6	39.4	15.4	6.1	.4	
3184704C	5	.63270.0	40.0	2164.0	955.7	249.8	78.0	7.3	
3184704C	2	.63270.0	60.0	1124.0	1019.6	464.5	204.1	67.3	
3184704C	3	.63270.0	60.0	29.3	26.5	13.9	5.3	1.4	
3184704C	4	.63270.0	60.0	33.9	36.3	18.1	8.9	3.6	
3184704C	5	.63270.0	60.0	957.3	857.7	433.1	146.2	36.3	
3184402CX	2	.63180.0	5.0	1526.9	573.8	47.0	12.8	5.7	
3184402CX	3	.63180.0	5.0	37.6	19.7	5.3	.8	.2	
3184402CX	4	.63180.0	5.0	49.0	17.5	1.3	.4	.2	
3184402CX	5	.63180.0	5.0	938.4	456.1	118.7	18.5	6.1	
3184402CX	2	.63180.0	20.0	1638.4	624.2	49.4	14.4	6.0	
3184402CX	3	.63180.0	20.0	19.6	14.8	1.4	.3	.1	
3184402CX	4	.63180.0	20.0	64.6	22.8	1.8	.4	.1	
3184402CX	5	.63180.0	20.0	1051.0	528.4	65.3	17.1	6.5	
3184402CX	2	.63180.0	40.0	1546.9	807.0	262.8	48.7	6.3	
3184402CX	3	.63180.0	40.0	58.6	26.3	3.3	.5	.2	
3184402CX	4	.63180.0	40.0	71.8	42.4	16.5	3.0	.3	
3184402CX	5	.63180.0	40.0	971.6	491.3	108.4	24.3	6.8	
3184402CX	2	.63180.0	60.0	1596.3	953.9	483.4	231.3	43.7	
3184402CX	3	.63180.0	60.0	66.6	39.9	22.0	12.7	3.4	
3184402CX	4	.63180.0	60.0	112.6	67.1	38.4	18.1	2.8	
3184402CX	5	.63180.0	60.0	762.0	441.6	231.8	129.4	35.2	
3184403CX	2	.63270.0	5.0	608.5	301.4	72.1	15.2	5.0	
3184403CX	3	.63270.0	5.0	6.8	8.8	5.5	1.1	.3	
3184403CX	4	.63270.0	5.0	19.1	8.0	1.4	.2	.1	
3184403CX	5	.63270.0	5.0	246.9	298.7	161.2	30.6	6.0	
3184403CX	2	.63270.0	20.0	744.9	261.8	34.1	6.1	2.2	
3184403CX	3	.63270.0	20.0	39.5	12.0	1.3	.3	.1	
3184403CX	4	.63270.0	20.0	23.9	8.6	1.0	.2	.1	
3184403CX	5	.63270.0	20.0	938.0	349.1	58.6	10.5	3.6	
3184403CX	2	.63270.0	40.0	421.5	198.2	39.1	6.1	2.2	
3184403CX	3	.63270.0	40.0	79.9	31.1	4.9	.4	.1	
3184403CX	4	.63270.0	40.0	15.3	7.2	1.1	.2	.1	
3194403CX	5	.63270.0	40.0	1257.2	606.3	149.1	13.7	3.8	
3184403CX	2	.63270.0	60.0	243.6	160.9	62.7	6.8	2.4	
3184403CX	3	.63270.0	60.0	215.1	94.9	21.4	4.0	.3	
3184403CX	4	.63270.0	60.0	11.7	7.5	2.8	.3	.1	
3184403CX	5	.63270.0	60.0	2191.3	1413.0	524.2	118.6	6.6	
3184501CX	2	.63270.0	5.0	735.2	372.0	78.7	17.6	5.1	
3184501CX	3	.63270.0	5.0	18.6	14.8	3.2	.8	.2	
3184501CX	4	.63270.0	5.0	19.6	10.2	2.0	.5	.2	
3184501CX	5	.63270.0	5.0	544.8	361.0	148.3	40.9	3.9	
3184501CX	2	.63270.0	20.0	704.4	390.6	138.4	26.6	5.3	
3184501CX	3	.63270.0	20.0	17.6	9.4	3.4	.7	.1	
3184501CX	4	.63270.0	20.0	18.0	9.9	3.0	.7	.2	
3184501CX	5	.63270.0	20.0	880.8	453.0	156.8	35.8	5.0	
3184501CX	2	.63270.0	40.0	408.2	222.8	76.8	19.5	4.1	
3184501CX	3	.63270.0	40.0	18.8	14.2	7.5	3.4	.6	
3184501CX	4	.63270.0	40.0	13.9	7.9	2.0	.5	.2	
3184501CX	5	.63270.0	40.0	692.5	540.0	325.9	158.1	24.9	
3184501CX	2	.63270.0	60.0	222.6	136.3	57.7	28.9	9.3	

SAMPLE	A C MFG PRIME P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3184501CX	3	.63	270.0	60.0	56.1	33.5	10.2	4.1	.9	
3184501CX	4	.63	270.0	60.0	3.2	1.9	.8	.4	.3	
3184501CX	5	.63	270.0	60.0	3470.7	1951.7	496.7	111.4	63.2	
3184601CX	2	.63	180.0	5.0	805.2	413.5	121.1	16.8	3.1	
3184601CX	3	.63	180.0	5.0	25.0	13.2	4.1	.7	.1	
3184601CX	4	.63	180.0	5.0	42.2	20.5	4.8	.8	.2	
3184601CX	5	.63	180.0	5.0	749.5	435.9	148.0	25.6	2.2	
3184601CX	2	.63	180.0	20.0	559.1	343.5	139.3	31.7	4.4	
3184601CX	3	.63	180.0	20.0	56.7	21.2	3.2	.3	.2	
3184601CX	4	.63	180.0	20.0	36.2	18.5	6.8	1.3	.3	
3184601CX	5	.63	180.0	20.0	1423.9	561.0	97.8	9.4	3.3	
3184601CX	2	.63	180.0	40.0	387.9	226.2	56.9	8.8	3.4	
3184601CX	3	.63	180.0	40.0	93.6	41.3	8.1	1.2	.2	
3184601CX	4	.63	180.0	40.0	27.2	15.4	3.7	.6	.3	
3184601CX	5	.63	180.0	40.0	2323.2	995.1	220.1	33.5	4.3	
3184601CX	2	.63	180.0	60.0	322.6	162.9	58.4	21.9	11.0	
3184601CX	3	.63	180.0	60.0	189.8	122.8	42.4	7.9	1.2	
3184601CX	4	.63	180.0	60.0	8.1	4.2	1.5	1.1	1.2	
3184601CX	5	.63	180.0	60.0	4121.4	2660.0	833.9	158.9	25.8	
3184701CX	2	.63	180.0	5.0	804.1	337.8	51.4	6.7	2.4	
3184701CX	3	.63	180.0	5.0	23.2	13.6	1.2	.2	.1	
3184701CX	4	.63	180.0	5.0	28.8	13.5	2.1	.3	.1	
3184701CX	5	.63	180.0	5.0	972.8	580.9	64.4	4.1	2.0	
3184701CX	2	.63	180.0	20.0	1146.3	430.6	40.8	5.7	2.3	
3184701CX	3	.63	180.0	20.0	17.8	15.6	.9	.2	.1	
3184701CX	4	.63	180.0	20.0	48.3	16.3	1.3	.2	.1	
3184701CX	5	.63	180.0	20.0	642.0	565.3	39.5	3.7	2.4	
3184701CX	2	.63	180.0	40.0	340.3	198.0	11.4	2.2	2.0	
3184701CX	3	.63	180.0	40.0	31.0	16.2	.4	.2	.2	
3184701CX	4	.63	180.0	40.0	14.9	9.5	.7	.3	.2	
3184701CX	5	.63	180.0	40.0	706.8	363.3	22.9	3.6	3.3	
3184701CX	2	.63	180.0	60.0	433.5	164.2	16.3	3.7	2.8	
3184701CX	3	.63	180.0	60.0	259.6	60.3	4.7	.9	.9	
3184701CX	4	.63	180.0	60.0	9.4	3.7	.4	.3	.3	
3184701CX	5	.63	180.0	60.0	1378.9	781.0	44.6	7.8	5.2	
3184703CX	2	.63	90.0	5.0	893.3	391.3	50.3	4.1	1.1	
3184703CX	3	.63	90.0	5.0	24.0	9.0	.9	.1	.1	
3184703CX	4	.63	90.0	5.0	31.7	11.3	1.8	.2	.1	
3184703CX	5	.63	90.0	5.0	1467.9	405.7	20.5	1.6	1.1	
3184703CX	2	.63	90.0	20.0	1008.4	265.3	11.1	1.4	1.0	
3184703CX	3	.63	90.0	20.0	31.1	6.2	.4	.1	.1	
3184703CX	4	.63	90.0	20.0	33.7	9.3	.7	.1	.1	
3184703CX	5	.63	90.0	20.0	1629.2	273.4	14.9	1.8	1.3	
3184703CX	2	.63	90.0	40.0	248.7	268.2	42.1	4.3	1.2	
3184703CX	3	.63	90.0	40.0	88.0	27.3	1.6	.1	.1	
3184703CX	4	.63	90.0	40.0	6.9	11.1	2.9	.4	.1	
3184703CX	5	.63	90.0	40.0	4077.2	1045.2	43.7	2.2	1.5	
3184703CX	2	.63	90.0	60.0	563.8	279.5	23.3	3.5	1.0	
3184703CX	3	.63	90.0	60.0	80.3	25.1	1.6	.5	.2	
3184703CX	4	.63	90.0	60.0	16.0	7.8	.5	.1	.1	
3184703CX	5	.63	90.0	60.0	3533.5	1157.3	76.9	14.0	2.7	
3184409C	2	1.06	.0	5.0	1131.9	1166.9	631.4	206.2	66.5	
3184409C	3	1.06	.0	5.0	11.8	13.6	8.0	7.1	5.4	
3184409C	4	1.06	.0	5.0	12.2	12.9	7.3	3.7	3.2	
3184409C	5	1.06	.0	5.0	1466.6	948.6	329.4	99.6	34.8	
3184409C	2	1.06	.0	20.0	147.0	965.9	584.7	166.3	49.6	
3184409C	3	1.06	.0	20.0	17.1	14.2	7.9	7.0	5.5	
3184409C	4	1.06	.0	20.0	18.5	15.7	8.9	4.7	5.0	
3184409C	5	1.06	.0	20.0	2127.0	1140.7	367.7	128.6	52.6	
3184409C	2	1.06	.0	40.0	483.9	922.4	597.3	217.9	72.3	
3184409C	3	1.06	.0	40.0	6.5	18.6	17.2	8.1	8.6	

SAMPLE	A/C MFG PRIME P CODE	λ	ϕ	θ	0^0-$.1^0$	$.1^0$-$.2^0$	$.2^0$-$.3^0$	$.3^0$-$.4^0$	$.4^0$-$.7^0$	$.7^0$-1.0^0
3184409C	4	1.06	.0	40.0	7.3	15.3	11.8	8.0	9.6	
3184409C	5	1.06	.0	40.0	848.0	1296.6	847.9	288.5	91.1	
3184409C	2	1.06	.0	60.0	781.7	847.6	646.2	383.9	140.6	
3184409C	3	1.06	.0	60.0	6.1	8.2	7.8	5.7	2.6	
3184409C	4	1.06	.0	60.0	7.4	6.8	4.7	2.8	1.4	
3184409C	5	1.06	.0	60.0	817.0	1030.0	848.8	492.5	201.1	
3184411C	2	1.06	270.0	5.0	1386.7	1252.9	447.7	115.0	23.5	
3184411C	3	1.06	270.0	5.0	10.1	8.7	2.4	.7	.3	
3184411C	4	1.06	270.0	5.0	18.3	16.9	8.1	1.1	1.3	
3184411C	5	1.06	270.0	5.0	1083.9	855.6	194.7	46.4	11.2	
3184411C	2	1.06	270.0	20.0	1327.0	1124.2	470.7	154.9	46.9	
3184411C	3	1.06	270.0	20.0	21.5	14.9	7.5	5.0	4.4	
3184411C	4	1.06	270.0	20.0	25.4	20.8	9.1	4.5	3.3	
3184411C	5	1.06	270.0	20.0	2872.1	1408.2	304.5	94.0	28.7	
3184411C	2	1.06	270.0	40.0	702.6	873.2	487.9	85.5	21.6	
3184411C	3	1.06	270.0	40.0	40.3	21.1	7.9	5.3	5.5	
3184411C	4	1.06	270.0	40.0	7.6	9.7	5.5	1.1	.4	
3184411C	5	1.06	270.0	40.0	5101.5	2043.0	362.3	82.4	26.8	
3184411C	2	1.06	270.0	60.0	176.4	358.4	533.6	409.7	133.2	
3184411C	3	1.06	270.0	60.0	14.8	18.0	17.2	11.7	8.1	
3184411C	4	1.06	270.0	60.0	1.4	2.5	3.6	2.9	1.0	
3184411C	5	1.06	270.0	60.0	719.8	995.4	873.7	470.2	165.9	
3184412C	2	1.06	270.0	5.0	237.7	182.1	87.9	22.8	6.1	
3184412C	3	1.06	270.0	5.0	.0	.0	.0	.0	.0	
3184412C	4	1.06	270.0	5.0	2.8	2.0	1.0	.5	.2	
3184412C	5	1.06	270.0	5.0	482.6	451.1	190.8	38.8	6.5	
3184412C	2	1.06	270.0	20.0	484.6	266.5	64.5	15.2	6.8	
3184412C	3	1.06	270.0	20.0	.0	.0	.0	.0	.0	
3184412C	4	1.06	270.0	20.0	4.3	2.3	.6	.3	.2	
3184412C	5	1.06	270.0	20.0	658.7	542.5	156.2	24.8	5.2	
3184412C	2	1.06	270.0	40.0	193.7	88.2	18.5	4.5	1.9	
3184412C	3	1.06	270.0	40.0	.0	.0	.0	.0	.0	
3184412C	4	1.06	270.0	40.0	.2	.3	.1	.1	.1	
3184412C	5	1.06	270.0	40.0	3418.2	1147.6	174.4	17.3	3.2	
3184412C	2	1.06	270.0	60.0	265.6	196.4	72.4	21.2	6.4	
3184412C	3	1.06	270.0	60.0	23.2	23.4	3.0	.3	.1	
3184412C	4	1.06	270.0	60.0	.0	.0	.0	.0	.0	
3184412C	5	1.06	270.0	60.0	5158.5	2728.6	1294.9	527.8	61.6	
3184509C	2	1.06	.0	5.0	941.8	889.3	560.0	270.1	68.1	
3184509C	3	1.06	.0	5.0	13.4	16.0	16.7	7.9	3.0	
3184509C	4	1.06	.0	5.0	9.0	9.6	7.3	5.1	2.6	
3184509C	5	1.06	.0	5.0	1342.3	1493.9	956.5	306.3	77.7	
3184509C	2	1.06	.0	20.0	3418.6	1244.5	266.5	76.7	28.1	
3184509C	3	1.06	.0	20.0	17.5	18.8	9.2	4.9	5.0	
3184509C	4	1.06	.0	20.0	22.7	10.4	4.1	2.7	3.6	
3184509C	5	1.06	.0	20.0	1476.0	845.4	245.1	63.6	20.7	
3184509C	2	1.06	.0	40.0	3128.1	1455.5	278.6	72.0	26.8	
3184509C	3	1.06	.0	40.0	41.1	22.0	10.9	8.3	7.4	
3184509C	4	1.06	.0	40.0	19.7	14.3	6.5	4.7	3.5	
3184509C	5	1.06	.0	40.0	3235.2	1607.8	439.4	124.7	41.0	
3184509C	2	1.06	.0	60.0	979.9	1342.8	883.2	345.7	89.4	
3184509C	3	1.06	.0	60.0	56.0	53.5	35.0	22.5	14.7	
3184509C	4	1.06	.0	60.0	21.7	20.6	17.5	11.6	9.8	
3184509C	5	1.06	.0	60.0	2145.1	2192.1	1116.1	408.2	133.7	
3184511C	2	1.06	270.0	5.0	2194.6	1016.8	298.0	74.9	24.3	
3184511C	3	1.06	270.0	5.0	38.4	23.8	7.0	1.1	.3	
3184511C	4	1.06	270.0	5.0	42.3	19.8	8.0	4.0	2.6	
3184511C	5	1.06	270.0	5.0	3153.6	1740.2	455.9	66.4	14.1	
3184511C	2	1.06	270.0	20.0	2044.6	1135.0	412.3	125.0	37.3	
3184511C	3	1.06	270.0	20.0	55.2	29.1	8.4	1.0	.3	
3184511C	4	1.06	270.0	20.0	45.0	20.7	10.0	6.0	3.5	

SAMPLE A C MFG PRIME	P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3184511C	5	1.06	270.0	20.0	3741.5	2076.0	587.3	43.1	7.2	
3184511C	2	1.06	270.0	40.0	1068.8	1230.2	612.7	196.8	58.7	
3184511C	3	1.06	270.0	40.0	34.8	28.2	14.1	4.6	.7	
3184511C	4	1.06	270.0	40.0	24.6	29.1	14.2	7.8	7.5	
3184511C	5	1.06	270.0	40.0	2534.4	2073.5	1008.1	345.4	34.8	
3184511C	2	1.06	270.0	60.0	266.4	370.6	302.2	188.1	70.3	
3184511C	3	1.06	270.0	60.0	27.1	12.3	4.7	2.8	1.0	
3184511C	4	1.06	270.0	60.0	8.3	13.4	13.9	12.3	10.4	
3184511C	5	1.06	270.0	60.0	1945.6	884.0	324.1	194.4	53.7	
3184609C	2	1.06	.0	5.0	789.1	820.9	445.5	178.0	58.9	
3184609C	3	1.06	.0	5.0	12.4	9.0	5.7	4.2	3.1	
3184609C	4	1.06	.0	5.0	6.4	7.8	6.2	3.8	3.2	
3184609C	5	1.06	.0	5.0	2056.1	1138.9	333.7	109.7	39.4	
3184609C	2	1.06	.0	20.0	1387.8	1033.6	530.5	193.1	69.4	
3184609C	3	1.06	.0	20.0	12.1	10.8	9.3	5.4	6.1	
3184609C	4	1.06	.0	20.0	13.2	11.4	7.3	4.4	2.9	
3184609C	5	1.06	.0	20.0	1546.3	1182.1	541.6	212.3	72.1	
3184609C	2	1.06	.0	40.0	2750.1	1259.7	390.5	98.0	33.3	
3184609C	3	1.06	.0	40.0	20.8	16.8	9.2	5.4	5.7	
3184609C	4	1.06	.0	40.0	18.5	10.7	4.9	4.6	3.8	
3184609C	5	1.06	.0	40.0	1412.8	901.2	419.3	146.6	50.2	
3184609C	2	1.06	.0	60.0	1802.4	1202.0	728.0	386.8	123.4	
3184609C	3	1.06	.0	60.0	17.3	22.6	25.0	22.0	10.9	
3184609C	4	1.06	.0	60.0	11.2	12.0	10.9	8.4	7.2	
3184609C	5	1.06	.0	60.0	1583.0	1553.0	1587.1	1288.4	283.6	
3184611C	2	1.06	270.0	5.0	1328.4	879.7	383.7	139.3	46.7	
3184611C	3	1.06	270.0	5.0	21.3	15.6	7.3	4.3	4.2	
3184611C	4	1.06	270.0	5.0	258.8	173.3	66.0	24.4	9.6	
3184611C	5	1.06	270.0	5.0	1195.9	992.4	352.2	116.9	37.6	
3184611C	2	1.06	270.0	20.0	3330.3	1997.5	617.6	187.1	52.7	
3184611C	3	1.06	270.0	20.0	11.8	16.7	8.4	5.7	5.1	
3184611C	4	1.06	270.0	20.0	45.1	31.2	14.1	6.8	4.2	
3184611C	5	1.06	270.0	20.0	1237.8	1314.4	356.9	110.9	33.8	
3184611C	2	1.06	270.0	40.0	1361.0	1145.4	599.9	364.5	139.3	
3184611C	3	1.06	270.0	40.0	15.8	9.5	6.0	4.4	4.0	
3184611C	4	1.06	270.0	40.0	24.7	22.4	15.0	11.7	9.5	
3184611C	5	1.06	270.0	40.0	1506.2	1140.1	462.6	155.0	51.4	
3184611C	2	1.06	270.0	60.0	1058.0	1443.3	1263.1	544.9	179.3	
3184611C	3	1.06	270.0	60.0	15.0	18.4	16.9	13.5	12.6	
3184611C	4	1.06	270.0	60.0	30.8	39.3	35.0	18.1	12.5	
3184611C	5	1.06	270.0	60.0	584.6	908.5	591.7	321.4	160.6	
3184410CX	2	1.06	.0	5.0	314.5	320.9	123.7	25.2	8.3	
3184410CX	3	1.06	.0	5.0	7.0	3.1	.5	.2	.1	
3184410CX	4	1.06	.0	5.0	1.4	1.5	.6	.2	.2	
3184410CX	5	1.06	.0	5.0	983.1	464.4	72.5	12.0	5.4	
3184410CX	2	1.06	.0	20.0	98.9	148.9	122.3	58.0	21.1	
3184410CX	3	1.06	.0	20.0	10.0	3.9	.5	.2	.1	
3184410CX	4	1.06	.0	20.0	.8	1.2	.8	.5	.3	
3184410CX	5	1.06	.0	20.0	1281.7	559.9	81.6	19.3	9.5	
3184410CX	2	1.06	.0	40.0	133.2	114.8	44.2	15.9	7.2	
3184410CX	3	1.06	.0	40.0	18.6	7.9	1.9	.5	.3	
3184410CX	4	1.06	.0	40.0	.7	.6	.3	.2	.2	
3184410CX	5	1.06	.0	40.0	1332.0	603.1	147.9	26.0	10.1	
3184410CX	2	1.06	.0	60.0	240.0	107.1	74.8	44.8	13.8	
3184410CX	3	1.06	.0	60.0	123.3	68.0	20.0	6.8	1.5	
3184410CX	4	1.06	.0	60.0	8.9	6.9	4.6	2.2	.9	
3184410CX	5	1.06	.0	60.0	6496.6	3803.3	1265.1	315.7	19.6	
3184510CX	2	1.06	.0	5.0	186.1	178.0	87.0	27.9	8.8	
3184510CX	3	1.06	.0	5.0	1.9	1.8	.8	.3	.3	
3184510CX	4	1.06	.0	5.0	2.5	2.8	1.5	.5	.2	
3184510CX	5	1.06	.0	5.0	170.8	163.1	69.3	12.3	4.0	

SAMPLE	A/C	MFG	PRIME	P CODE	λ	φ	θ	0°-.1°	.1°-.2°	.2°-.3°	.3°-.4°	.4°-.7°	.7°-1.0°
3184510CX				2	1.06	.0	20.0	308.8	228.7	105.3	33.2	15.2	
3184510CX				3	1.06	.0	20.0	4.8	3.3	1.2	.5	.4	
3184510CX				4	1.06	.0	20.0	4.8	3.6	1.6	.5	.3	
3184510CX				5	1.06	.0	20.0	624.8	396.8	113.3	34.0	27.4	
3184510CX				2	1.06	.0	40.0	145.9	138.0	89.3	40.5	13.7	
3184510CX				3	1.06	.0	40.0	5.3	8.6	7.9	4.0	1.3	
3184510CX				4	1.06	.0	40.0	1.8	1.7	1.1	.6	.4	
3184510CX				5	1.06	.0	40.0	2179.8	1525.5	1351.3	1108.1	281.3	
3184510CX				2	1.06	.0	60.0	226.8	161.8	95.6	43.0	18.9	
3184510CX				3	1.06	.0	60.0	113.5	67.7	25.7	7.1	1.3	
3184510CX				4	1.06	.0	60.0	14.9	11.7	7.4	4.0	1.1	
3184510CX				5	1.06	.0	60.0	7970.8	4243.0	1537.8	381.7	54.5	
3184512CX				2	1.0627	0.0	5.0	494.3	365.0	154.4	62.1	22.0	
3184512CX				3	1.0627	0.0	5.0	7.1	4.1	1.9	.8	.3	
3184512CX				4	1.0627	0.0	5.0	7.2	6.7	3.1	1.2	.4	
3184512CX				5	1.0627	0.0	5.0	550.2	308.2	141.5	50.2	15.9	
3184512CX				2	1.0627	0.0	20.0	387.3	266.7	116.6	44.4	14.3	
3184512CX				3	1.0627	0.0	20.0	5.6	4.8	3.4	1.6	.6	
3184512CX				4	1.0627	0.0	20.0	4.3	4.9	2.6	.7	.2	
3184512CX				5	1.0627	0.0	20.0	488.1	350.4	229.4	96.1	28.3	
3184512CX				2	1.0627	0.0	40.0	297.2	174.2	85.1	40.8	13.3	
3184512CX				3	1.0627	0.0	40.0	28.9	25.7	12.4	4.6	2.6	
3184512CX				4	1.0627	0.0	40.0	3.7	2.2	1.1	.5	.2	
3184512CX				5	1.0627	0.0	40.0	1453.8	1105.2	395.8	92.4	28.3	
3184512CX				2	1.0627	0.0	60.0	168.0	197.9	135.7	72.0	27.5	
3184512CX				3	1.0627	0.0	60.0	84.7	100.3	74.6	34.0	16.6	
3184512CX				4	1.0627	0.0	60.0	7.8	12.4	10.8	5.5	2.2	
3184512CX				5	1.0627	0.0	60.0	2645.0	3224.0	2522.9	1054.5	237.0	
3184610CX				2	1.06	.0	5.0	1045.9	794.7	481.6	249.0	88.0	
3184610CX				3	1.06	.0	5.0	21.1	5.8	1.0	.3	.1	
3184610CX				4	1.06	.0	5.0	16.2	13.0	8.8	6.4	4.8	
3184610CX				5	1.06	.0	5.0	1373.9	329.9	52.1	9.6	2.8	
3184610CX				2	1.06	.0	20.0	2698.9	1730.6	593.0	171.4	55.4	
3184610CX				3	1.06	.0	20.0	13.9	3.3	.7	.3	.2	
3184610CX				4	1.06	.0	20.0	36.4	23.4	11.8	5.8	4.3	
3184610CX				5	1.06	.0	20.0	1007.2	198.6	31.2	5.9	2.3	
3184610CX				2	1.06	.0	40.0	174.2	94.6	20.8	5.3	1.6	
3184610CX				3	1.06	.0	40.0	43.6	29.0	4.0	.7	.3	
3184610CX				4	1.06	.0	40.0	1.7	1.1	.3	.2	.2	
3184610CX				5	1.06	.0	40.0	1898.8	953.6	127.6	16.9	4.2	
3184610CX				2	1.06	.0	60.0	236.6	261.4	71.9	18.3	5.7	
3184610CX				3	1.06	.0	60.0	63.4	120.3	34.2	4.2	.9	
3184610CX				4	1.06	.0	60.0	16.8	13.6	4.3	1.2	.5	
3184610CX				5	1.06	.0	60.0	1231.7	1467.8	529.4	52.9	8.6	
3184612CX				2	1.0627	0.0	5.0	440.7	318.6	87.9	23.2	9.3	
3184612CX				3	1.0627	0.0	5.0	15.5	5.8	.9	.2	.1	
3184612CX				4	1.0627	0.0	5.0	8.3	7.6	3.7	3.7	2.4	
3184612CX				5	1.0627	0.0	5.0	957.4	396.5	60.0	9.0	2.2	
3184612CX				2	1.0627	0.0	20.0	404.8	247.4	44.5	9.5	2.6	
3184612CX				3	1.0627	0.0	20.0	14.2	9.8	1.0	.2	.2	
3184612CX				4	1.0627	0.0	20.0	4.3	3.1	.9	.3	.1	
3184612CX				5	1.0627	0.0	20.0	712.2	493.9	56.7	7.8	2.1	
3184612CX				2	1.0627	0.0	40.0	119.0	64.6	19.6	6.2	2.3	
3184612CX				3	1.0627	0.0	40.0	15.3	12.1	3.6	.6	.2	
3184612CX				4	1.0627	0.0	40.0	2.5	1.2	.3	.2	.1	
3184612CX				5	1.0627	0.0	40.0	626.8	509.0	160.8	21.2	3.4	
3184612CX				2	1.0627	0.0	60.0	79.2	120.8	68.0	20.6	6.3	
3184612CX				3	1.0627	0.0	60.0	104.4	43.3	8.3	1.0	.3	
3184612CX				4	1.0627	0.0	60.0	5.4	8.8	4.6	1.5	.5	
3184612CX				5	1.0627	0.0	60.0	4052.0	1676.9	313.3	40.3	6.0	
3185501C				6	.55	.0	5.0	335.4	282.7	202.9	116.9	43.4	

SAMPLE A C MFG PRIME	P CODE	λ	φ	θ	0^{0}-$.1^{0}$	$.1^{0}$-$.2^{0}$	$.2^{0}$-$.3^{0}$	$.3^{0}$-$.4^{0}$	$.4^{0}$-$.7^{0}$	$.7^{0}$-1.0^{0}
3185501C	7	.55	.0	5.0	316.3	269.5	194.2	113.3	41.6	
3185501C	6	.55	.0	20.0	260.2	241.6	191.9	134.1	58.5	
3185501C	7	.55	.0	20.0	311.5	247.0	186.4	125.4	54.0	
3185501C	6	.55	.0	40.0	319.2	266.7	187.1	99.9	32.3	
3185501C	7	.55	.0	40.0	291.8	248.6	179.6	101.3	47.5	
3185501C	6	.55	.0	60.0	291.3	239.5	165.5	95.6	37.5	
3185501C	7	.55	.0	60.0	211.3	186.3	130.8	79.8	59.4	
3185503C	6	.55	270.0	5.0	352.7	292.9	195.3	104.0	34.9	
3185503C	7	.55	270.0	5.0	352.5	289.3	192.8	101.7	34.4	
3185503C	6	.55	270.0	20.0	290.4	251.4	193.9	124.4	52.5	
3185503C	7	.55	270.0	20.0	291.4	244.8	189.0	118.9	50.6	
3185503C	6	.55	270.0	40.0	327.3	282.6	198.8	111.8	41.9	
3185503C	7	.55	270.0	40.0	308.0	265.8	187.0	105.1	39.5	
3185503C	6	.55	270.0	60.0	333.0	290.2	218.7	138.6	53.9	
3185503C	7	.55	270.0	60.0	256.9	225.4	171.7	111.1	44.0	
3185601C	6	.55	.0	5.0	236.7	197.7	134.3	82.8	37.7	
3185601C	7	.55	.0	5.0	250.0	206.9	139.0	86.5	39.1	
3185601C	6	.55	.0	20.0	265.8	238.3	181.5	115.3	53.4	
3185601C	7	.55	.0	20.0	272.7	249.0	195.5	121.4	56.1	
3185601C	6	.55	.0	40.0	282.2	240.5	182.8	121.6	58.9	
3185601C	7	.55	.0	40.0	283.0	241.8	183.3	122.3	60.0	
3185601C	6	.55	.0	60.0	268.1	252.4	217.6	174.4	92.3	
3185601C	7	.55	.0	60.0	230.1	217.7	189.2	149.5	81.3	
3185603C	6	.55	270.0	5.0	122.7	123.5	120.5	84.4	37.8	4.5
3185603C	7	.55	270.0	5.0	131.6	127.2	123.1	85.1	36.6	4.8
3185603C	6	.55	270.0	20.0	166.7	144.6	135.4	92.5	41.3	4.9
3185603C	7	.55	270.0	20.0	137.4	131.4	125.4	97.7	44.6	4.7
3185603C	6	.55	270.0	40.0	256.8	204.3	189.4	118.2	51.2	6.4
3185603C	7	.55	270.0	40.0	186.1	189.7	181.5	118.2	51.6	6.6
3185603C	6	.55	270.0	60.0	217.9	193.2	179.8	137.9	65.3	10.2
3185603C	7	.55	270.0	60.0	234.7	205.9	194.2	165.0	80.2	12.9
3185701C	6	.55	.0	5.0	443.6	356.2	176.1	60.8	17.7	
3185701C	7	.55	.0	5.0	493.6	371.2	178.9	59.7	14.7	
3185701C	6	.55	.0	20.0	531.5	396.7	187.1	63.2	14.6	
3185701C	7	.55	.0	20.0	497.9	354.9	188.0	66.2	17.2	
3185701C	6	.55	.0	40.0	615.6	442.8	197.0	65.8	16.5	
3185701C	7	.55	.0	40.0	571.6	412.8	187.4	67.1	19.5	
3185701C	6	.55	.0	60.0	637.5	495.4	270.1	109.1	31.5	
3185701C	7	.55	.0	60.0	541.6	411.9	218.9	89.2	27.2	
3185703C	6	.55	270.0	5.0	519.2	397.7	206.7	78.2	20.6	
3185703C	7	.55	270.0	5.0	603.7	447.3	214.8	74.8	15.8	
3185703C	6	.55	270.0	20.0	662.1	474.4	216.3	75.7	15.0	
3185703C	7	.55	270.0	20.0	677.8	483.4	226.1	79.0	15.4	
3185703C	6	.55	270.0	40.0	635.5	442.8	208.3	76.0	16.2	
3185703C	7	.55	270.0	40.0	583.2	415.5	202.8	78.7	18.0	
3185703C	6	.55	270.0	60.0	593.1	473.4	286.9	134.0	29.5	
3185703C	7	.55	270.0	60.0	450.7	379.2	228.7	109.4	26.3	
3185502CX	6	.55	.0	5.0	119.8	116.2	108.4	99.2	61.6	
3185502CX	7	.55	.0	5.0	125.7	130.9	114.4	96.3	58.5	
3185502CX	6	.55	.0	20.0	165.2	148.1	106.7	58.8	23.6	
3185502CX	7	.55	.0	20.0	230.1	189.6	136.0	73.8	29.3	
3185502CX	6	.55	.0	40.0	84.5	72.0	53.3	33.0	17.6	
3185502CX	7	.55	.0	40.0	298.0	259.8	178.5	107.2	47.5	
3185502CX	6	.55	.0	60.0	69.2	71.6	73.3	54.1	28.4	
3185502CX	7	.55	.0	60.0	420.5	364.9	342.2	261.3	135.4	
3185504CX	6	.55	270.0	5.0	222.8	197.4	151.7	90.7	35.0	
3185504CX	7	.55	270.0	5.0	244.5	210.6	160.8	94.7	35.6	
3185504CX	6	.55	270.0	20.0	220.0	186.7	128.1	69.4	29.2	
3185504CX	7	.55	270.0	20.0	276.4	236.8	164.7	89.5	37.8	
3185504CX	6	.55	270.0	40.0	114.4	104.0	73.5	44.1	17.9	
3185504CX	7	.55	270.0	40.0	411.0	360.9	239.4	134.4	49.9	

SAMPLE	A/C MFG PRIME P CODE	λ	φ	θ	0^{o}-$.1^{o}$	$.1^{o}$-$.2^{o}$	$.2^{o}$-$.3^{o}$	$.3^{o}$-$.4^{o}$	$.4^{o}$-$.7^{o}$	$.7^{o}$-1.0^{o}
3185504CX	6	.55	270.0	60.0	281.0	210.0	124.3	50.4	11.4	
3185504CX	7	.55	270.0	60.0	1681.3	1263.1	765.7	311.6	67.6	
3185602CX	6	.55	.0	5.0	172.7	175.1	144.8	89.7	30.7	
3185602CX	7	.55	.0	5.0	184.9	178.4	147.0	90.8	30.6	
3185602CX	6	.55	.0	20.0	161.4	148.6	114.3	68.4	23.0	
3185602CX	7	.55	.0	20.0	226.6	209.3	153.8	98.9	27.9	
3185602CX	6	.55	.0	40.0	142.3	106.8	57.9	26.6	11.3	
3185602CX	7	.55	.0	40.0	568.6	428.6	219.6	96.8	28.1	
3185602CX	6	.55	.0	60.0	174.1	138.9	82.1	36.9	10.9	
3185602CX	7	.55	.0	60.0	1375.1	1054.1	544.1	221.0	42.4	
3185604CX	6	.55	270.0	5.0	221.2	151.4	130.1	63.6	17.7	1.5
3185604CX	7	.55	270.0	5.0	230.4	156.2	133.2	65.6	19.0	1.8
3185604CX	6	.55	270.0	20.0	180.5	124.3	105.4	53.0	14.9	1.3
3185604CX	7	.55	270.0	20.0	293.5	179.9	147.1	67.2	18.2	1.4
3185604CX	6	.55	270.0	40.0	113.5	70.0	58.2	27.6	7.1	1.0
3185604CX	7	.55	270.0	40.0	376.9	265.3	224.3	106.6	27.8	2.3
3185604CX	6	.55	270.0	60.0	126.6	95.7	82.7	42.0	12.2	1.6
3185604CX	7	.55	270.0	60.0	1191.1	699.7	569.5	283.0	81.6	5.5
3185702CX	6	.55	.0	5.0	234.0	191.7	130.0	77.5	31.7	
3185702CX	7	.55	.0	5.0	230.5	189.9	131.5	79.5	13.8	
3185702CX	6	.55	.0	20.0	161.6	132.6	89.8	52.8	24.4	
3185702CX	7	.55	.0	20.0	229.1	181.2	123.1	72.3	33.0	
3185702CX	6	.55	.0	40.0	104.0	86.2	53.0	27.6	10.3	
3185702CX	7	.55	.0	40.0	408.5	339.2	208.9	107.1	39.2	
3185702CX	6	.55	.0	60.0	218.3	164.2	83.6	30.1	6.9	
3185702CX	7	.55	.0	60.0	1768.6	1259.2	627.6	217.8	42.7	
3185704CX	6	.55	270.0	5.0	133.7	101.2	92.4	57.3	24.3	2.6
3185704CX	7	.55	270.0	5.0	119.7	103.4	96.0	61.2	24.7	2.3
3185704CX	6	.55	270.0	20.0	112.1	84.6	77.1	50.9	23.2	3.0
3185704CX	7	.55	270.0	20.0	145.0	113.6	104.1	67.6	29.3	3.8
3185704CX	6	.55	270.0	40.0	63.5	48.0	43.9	30.2	13.1	3.3
3185704CX	7	.55	270.0	40.0	186.7	173.0	163.1	108.7	43.8	5.8
3185704CX	6	.55	270.0	60.0	111.9	91.3	87.5	59.5	24.8	3.9
3185704CX	7	.55	270.0	60.0	553.5	484.4	460.6	313.4	125.7	10.5
3190402A	6	.55	.0	5.0	7176.5	5477.2	3365.3	1462.6	315.0	
3190402A	7	.55	.0	5.0	7314.3	5623.5	3471.1	1486.5	309.2	
3190402A	6	.55	.0	20.0	8681.5	7136.1	3335.0	1206.0	141.8	
3190402A	7	.55	.0	20.0	9623.8	7100.3	3187.9	1009.0	123.6	
3190402A	6	.55	.0	40.0	8229.7	6007.5	3689.1	1579.0	323.1	
3190402A	7	.55	.0	40.0	9489.1	6305.6	3646.5	1541.3	239.7	
3190402A	6	.55	.0	60.0	13378.0	10060.4	5745.2	2278.2	411.9	
3190402A	7	.55	.0	60.0	12543.8	9700.6	5453.6	2407.8	542.8	
3190502A	6	.55	.0	5.0	7425.2	5666.8	3320.1	1267.1	172.5	
3190502A	7	.55	.0	5.0	7268.0	5615.0	3352.7	1264.8	144.8	
3190502A	6	.55	.0	20.0	9350.9	7639.3	3722.4	1393.0	240.8	
3190502A	7	.55	.0	20.0	9371.4	7389.4	3587.6	1343.7	235.2	
3190502A	6	.55	.0	40.0	8963.6	7479.6	4557.0	1615.9	149.3	
3190502A	7	.55	.0	40.0	8615.3	7089.6	4374.2	1677.2	207.9	
3190502A	6	.55	.0	60.0	16088.8	11761.8	5264.6	1680.1	171.6	
3190502A	7	.55	.0	60.0	13664.1	10552.9	5714.7	2118.6	354.4	
3190602A	6	.55	.0	5.0	7461.3	5301.8	2474.2	1009.4	242.3	
3190602A	7	.55	.0	5.0	6879.3	4941.1	2435.6	1063.0	280.8	
3190602A	6	.55	.0	20.0	9074.5	6649.5	3475.1	1009.9	211.0	
3190602A	7	.55	.0	20.0	9364.8	6725.1	3499.0	986.2	199.4	
3190602A	6	.55	.0	40.0	6075.0	5156.6	3357.8	1396.8	349.6	
3190602A	7	.55	.0	40.0	5602.9	4949.5	3188.0	1476.4	443.4	
3190602A	6	.55	.0	60.0	3931.2	4740.7	4298.8	2724.8	958.9	
3190602A	7	.55	.0	60.0	5113.2	4892.5	4030.0	2485.3	929.7	
3190401A	2	.63	.0	5.0	30829.3	9878.5	1652.7	162.2	24.3	
3190401A	3	.63	.0	5.0	1922.1	1246.1	150.8	59.8	37.9	
3190401A	4	.63	.0	5.0	1697.6	630.7	159.3	78.6	65.1	

SAMPLE A/C MFG PRIME	P CODE	λ	φ	θ	0^o-$.1^o$	$.1^o$-$.2^o$	$.2^o$-$.3^o$	$.3^o$-$.4^o$	$.4^o$-$.7^o$	$.7^o$-1.0^o
3190401A	5	.63	.0	5.0	60199.8	27137.1	1536.1	175.0	105.3	
3190401A	2	.63	.0	20.0	42771.5	7143.1	977.1	82.3	13.0	
3190401A	3	.63	.0	20.0	1587.4	1215.5	111.1	34.6	36.3	
3190401A	4	.63	.0	20.0	1510.2	443.6	157.3	92.1	75.9	
3190401A	5	.63	.0	20.0	41576.1	31933.9	2234.3	157.7	76.0	
3190401A	2	.63	.0	40.0	59649.4	7536.3	745.7	147.4	33.8	
3190401A	3	.63	.0	40.0	3039.5	555.5	38.0	8.9	4.1	
3190401A	4	.63	.0	40.0	2122.0	360.6	102.7	97.1	87.9	
3190401A	5	.63	.0	40.0	91096.2	17925.5	843.5	45.5	9.8	
3190401A	2	.63	.0	60.0	88070.2	27772.2	2699.1	236.4	43.6	
3190401A	3	.63	.0	60.0	1232.1	783.3	320.6	44.1	4.9	
3190401A	4	.63	.0	60.0	2454.2	1057.4	229.9	157.2	139.6	
3190401A	5	.63	.0	60.0	213955.7	44190.8	13417.2	1291.7	123.7	
3190501A	2	.63	.0	5.0	20541.9	17440.2	3930.1	491.1	87.1	
3190501A	3	.63	.0	5.0	1187.1	380.8	58.0	9.0	5.6	
3190501A	4	.63	.0	5.0	708.6	653.7	159.6	21.2	6.1	
3190501A	5	.63	.0	5.0	39484.5	10418.5	1688.5	217.3	50.0	
3190501A	2	.63	.0	20.0	16295.3	15960.9	3652.1	423.3	80.8	
3190501A	3	.63	.0	20.0	1779.3	622.2	89.0	10.3	5.5	
3190501A	4	.63	.0	20.0	665.3	741.5	162.4	19.0	4.9	
3190501A	5	.63	.0	20.0	61545.0	17775.7	2505.5	340.6	60.8	
3190501A	2	.63	.0	40.0	40276.0	7740.3	1372.3	248.3	59.2	
3190501A	3	.63	.0	40.0	2218.0	926.3	100.5	12.0	6.2	
3190501A	4	.63	.0	40.0	1812.3	1030.7	268.0	137.2	80.7	
3190501A	5	.63	.0	40.0	79379.0	29606.8	2984.1	363.1	76.4	
3190501A	2	.63	.0	60.0	71460.5	28847.6	4135.8	539.3	76.8	
3190501A	3	.63	.0	60.0	1555.9	1427.2	728.8	112.5	15.6	
3190501A	4	.63	.0	60.0	3516.6	1293.1	132.7	8.8	5.5	
3190501A	5	.63	.0	60.0	41112.3	35989.0	17611.5	2574.7	128.2	
3190601A	2	.63	.0	5.0	20613.5	26812.4	12305.0	153.8	27.0	
3190601A	3	.63	.0	5.0	1787.1	117.9	9.9	5.9	5.3	
3190601A	4	.63	.0	5.0	1367.9	1773.7	765.5	20.7	7.9	
3190601A	5	.63	.0	5.0	35767.8	2468.5	149.7	27.2	22.7	
3190601A	2	.63	.0	20.0	68690.0	12110.2	901.4	134.1	31.6	
3190601A	3	.63	.0	20.0	3810.4	1100.1	26.2	4.3	5.4	
3190601A	4	.63	.0	20.0	4499.7	959.9	43.5	7.5	8.4	
3190601A	5	.63	.0	20.0	77016.5	22565.8	603.2	53.8	19.9	
3190601A	2	.63	.0	40.0	93084.1	32534.5	2239.5	245.6	51.3	
3190601A	3	.63	.0	40.0	3942.1	873.9	33.7	3.8	4.9	
3190601A	4	.63	.0	40.0	5633.9	2012.7	165.3	23.7	11.4	
3190601A	5	.63	.0	40.0	68659.5	19837.1	1394.5	25.9	23.7	
3190601A	2	.63	.0	60.0	72824.4	36386.7	6204.1	790.8	141.4	
3190601A	3	.63	.0	60.0	1809.0	1572.1	537.0	52.0	7.0	
3190601A	4	.63	.0	60.0	4590.2	2650.5	405.0	51.1	17.7	
3190601A	5	.63	.0	60.0	27431.9	25650.5	8439.4	813.5	53.9	
3190403A	2	1.06	.0	5.0	15051.7	15640.2	3857.1	626.3	138.9	
3190403A	3	1.06	.0	5.0	775.0	210.0	32.6	7.5	4.3	
3190403A	4	1.06	.0	5.0	310.6	307.4	70.0	9.4	4.9	
3190403A	5	1.06	.0	5.0	34098.3	9067.1	1315.0	237.4	54.6	
3190403A	2	1.06	.0	20.0	29293.3	10720.3	2647.8	471.5	97.9	
3190403A	3	1.06	.0	20.0	442.4	300.5	70.7	16.4	6.8	
3190403A	4	1.06	.0	20.0	543.1	206.2	54.3	12.7	7.9	
3190403A	5	1.06	.0	20.0	18605.2	12814.4	3388.1	768.7	176.5	
3190403A	2	1.06	.0	40.0	5770.0	16795.6	12127.3	3104.1	639.0	
3190403A	3	1.06	.0	40.0	581.8	157.1	49.6	18.5	8.1	
3190403A	4	1.06	.0	40.0	1140.1	4125.1	3499.5	792.3	155.1	
3190403A	5	1.06	.0	40.0	27975.1	7756.7	1981.6	535.2	163.2	
3190403A	2	1.06	.0	60.0	46451.1	41727.6	15341.6	3717.3	820.3	
3190403A	3	1.06	.0	60.0	233.4	216.2	143.6	65.5	23.5	
3190403A	4	1.06	.0	60.0	1121.5	1088.6	350.6	82.6	24.1	
3190403A	5	1.06	.0	60.0	10501.5	8395.4	5315.0	2553.7	469.3	

SAMPLE	A/C MFG PRIME P CODE	λ	φ	θ	0°-$.1^\circ$	$.1^\circ$-$.2^\circ$	$.2^\circ$-$.3^\circ$	$.3^\circ$-$.4^\circ$	$.4^\circ$-$.7^\circ$	$.7^\circ$-1.0°
3190503A	2	1.06	.0	5.0	26899.3	29478.7	10224.9	2289.5	522.4	
3190503A	3	1.06	.0	5.0	672.9	536.3	130.8	20.9	5.9	
3190503A	4	1.06	.0	5.0	611.5	657.5	242.8	58.8	19.0	
3190503A	5	1.06	.0	5.0	33945.0	25595.4	5103.3	659.8	126.5	
3190503A	2	1.06	.0	20.0	25245.7	13246.8	2448.5	398.3	79.5	
3190503A	3	1.06	.0	20.0	770.9	792.1	171.[illegible]	15.4	6.3	
3190503A	4	1.06	.0	20.0	164.3	177.1	37.3	9.6	7.1	
3190503A	5	1.06	.0	20.0	34474.8	36477.2	8853.9	1157.8	213.9	
3190503A	2	1.06	.0	40.0	7263.1	19101.8	12058.5	2739.3	579.4	
3190503A	3	1.06	.0	40.0	490.9	248.9	46.9	9.0	6.3	
3190503A	4	1.06	.0	40.0	157.4	411.1	270.9	49.7	12.7	
3190503A	5	1.06	.0	40.0	22761.1	10530.0	1995.3	257.1	45.2	
3190503A	2	1.06	.0	60.0	49611.3	35103.9	11598.7	3508.5	1016.4	
3190503A	3	1.06	.0	60.0	449.4	517.6	262.7	83.7	23.6	
3190503A	4	1.06	.0	60.0	1415.2	911.7	256.9	74.2	24.0	
3190503A	5	1.06	.0	60.0	20076.4	22754.8	11505.8	2682.6	450.8	
3190603A	2	1.06	.0	5.0	45967.0	28326.7	1544.8	81.4	12.1	
3190603A	3	1.06	.0	5.0	299.6	61.1	10.4	7.6	5.4	
3190603A	4	1.06	.0	5.0	366.2	162.3	18.3	7.4	7.1	
3190603A	5	1.06	.0	5.0	38445.9	8095.4	861.7	67.1	13.3	
3190603A	2	1.06	.0	20.0	35030.1	17682.3	2954.8	326.4	49.0	
3190603A	3	1.06	.0	20.0	316.6	92.0	17.9	8.6	5.7	
3190603A	4	1.06	.0	20.0	213.6	129.3	33.2	10.1	7.0	
3190603A	5	1.06	.0	20.0	41031.9	11110.0	1434.1	195.5	32.4	
3190603A	2	1.06	.0	40.0	42152.3	24407.1	3063.5	368.1	56.4	
3190603A	3	1.06	.0	40.0	410.4	99.3	36.3	13.3	8.5	
3190603A	4	1.06	.0	40.0	290.6	181.8	38.4	10.7	6.9	
3190603A	5	1.06	.0	40.0	63729.5	14690.5	1578.1	279.0	45.7	
3190603A	2	1.06	.0	60.0	41457.4	20556.6	7895.6	2175.1	102.3	
3190603A	3	1.06	.0	60.0	265.7	151.6	84.0	56.9	21.7	
3190503A	4	1.06	.0	60.0	337.8	177.8	83.5	35.1	13.2	
3190603A	5	1.06	.0	60.0	41196.1	20113.4	10729.7	6444.7	1350.2	
3194501A	6	.55	270.0	5.0	1649.7	1410.0	1312.3	967.8	554.8	180.8
3194501A	7	.55	270.0	5.0	1666.2	1427.7	1333.5	988.3	566.5	184.3
3194501A	6	.55	270.0	20.0	1989.6	1645.2	1545.5	1183.7	726.7	232.4
3194501A	7	.55	270.0	20.0	2065.2	1741.0	1591.6	1223.0	756.1	242.3
3194501A	6	.55	270.0	40.0	4037.8	3361.5	3006.6	2279.1	1295.9	373.3
3194501A	7	.55	270.0	40.0	3943.7	3387.0	3048.1	2322.9	1355.0	391.6
3194501A	6	.55	270.0	60.0	3065.1	3048.5	2909.8	2373.5	1538.8	452.7
3194501A	7	.55	270.0	60.0	3952.4	3366.8	3141.7	2459.5	1544.8	443.2
3194601A	6	.55	180.0	5.0	1212.0	1200.9	1195.6	1152.9	891.7	288.1
3194601A	7	.55	180.0	5.0	1203.1	1198.4	1191.3	1143.6	884.1	287.0
3194601A	6	.55	180.0	20.0	1195.9	1105.1	1073.9	983.8	688.7	199.8
3194601A	7	.55	180.0	20.0	1219.1	1117.1	1076.4	980.3	681.9	197.6
3194601A	6	.55	180.0	40.2	1652.3	1609.3	1596.1	1210.4	703.2	173.8
3194601A	7	.55	180.0	40.2	1791.6	1695.8	1652.1	1219.8	693.4	176.3
3194601A	6	.55	180.0	60.0	2706.7	2559.4	2503.4	1976.1	1088.6	153.5
3194601A	7	.55	180.0	60.0	3933.3	3157.0	2933.1	1984.8	994.7	167.8
3194701A	6	.55	90.0	5.0	1581.1	1475.8	1426.4	1167.3	636.0	82.8
3194701A	7	.55	90.0	5.0	1642.0	1521.7	1467.7	1196.2	651.8	82.7
3194701A	6	.55	90.0	20.0	1727.5	1578.5	1510.7	1182.7	629.3	90.2
3194701A	7	.55	90.0	20.0	1788.9	1632.9	1565.9	1224.4	646.6	91.4
3194701A	6	.55	90.0	40.0	2064.3	1848.8	1741.3	1299.9	689.4	98.9
3194701A	7	.55	90.0	40.0	2288.8	1981.8	1856.4	1354.2	693.8	104.6
3194701A	6	.55	90.0	60.0	3427.5	2859.1	2622.8	1837.7	974.6	142.0
3194701A	7	.55	90.0	60.0	3952.2	3124.4	2812.7	1977.6	1009.0	154.0

Appendix E
BIDIRECTIONAL REFLECTANCE MEASUREMENTS AT 10.6 μm

A computer listing of the bidirectional reflectance data (ρ') acquired at 10.6 μm is reported. At 10.6 μm all ρ' data were measured with a fixed bistatic angle of 0.26 degree; i.e., the angle between the source and receiver was fixed and the sample was rotated. The bistatic angle (β) is depicted in Figure E-1. For a given scan plane, the relationship between β and the source and receiver zenith angles (θ_i and θ_r, respectively) can be expressed as

$$\theta_i = |\theta_r + \beta|$$

where β, necessarily, takes on both positive and negative values while, by definition, θ_i and θ_r are always positive. The sign of β changes when the azimuth angle shifts by 180° as the receiver passes through the sample normal as depicted in Figure E-1.

The measured data found in this appendix has been placed into the standardized ERAS format for which computer listings are found in the tabulated data. A summary of the tabulations given in Table E-1 also gives the significant measurement parameters used. The data tabulation is basically that of the ERAS format which is described in Appendix F. Although complete data are not presented in the tabulation, measurements of the cross-polarized components (PCODEs 3 and 4) were attempted for the specular samples. The values measured were below the peak by a factor of 100 and were ambiguous, because this factor is comparable to the extinction of the wire grid polarizer. Thus, it is impossible to determine whether the measured energy is due to the depolarized component or polarizer leakage. Therefore, the depolarized data is ambiguous and is not presented.

The following example is used to illustrate the interpretation of the tabular data contained herein. An exerpt from the data tabulation is shown in Figure E-2 for illustration.

In Figure E-2, the sample number, area condition number, etc., are all given using the standard ERAS format (Appendix F). In the example it should be noted the columns 16 and 17 are being used to denote the measurement curve "run number" and 18 the data set number.

For each data curve acquired, a "run number" was assigned, and all data utilizing a specific "run number" have been used in reconstruction of the data curve. In most cases where the bistatic angle (β) is fixed, up to three data sets are necessary to mechanically enter the information into the ERAS format. This is apparent from Figure E-1, if a scan of the detector and source is made which extends from one side of the sample normal to the other in a given plane. Here, it is noted that the azimuth parameters of both the source (ϕ_i) and receiver (ϕ_r) change at different times. Therefore, changes in the independent parameters (YCODE2) are required, thereby generating a new data set. The second significant change is that the source zenith angle (θ_i) is replaced by the value of β since both θ_i and θ_r are dependent functions in the fixed bistatic measurement.

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To further illustrate, the data in Figure E-2 are plotted in Figure E-3 which shows that portion of the curve which relates to a particular data set. In all cases the data are contained on the lines corresponding to the "92 card" inputs with the data values (ρ') being preceded by the measurement angle (θ_r). Six spaces are allowed for each angle and data values as shown in Figure E-3 and explained in Appendix F.

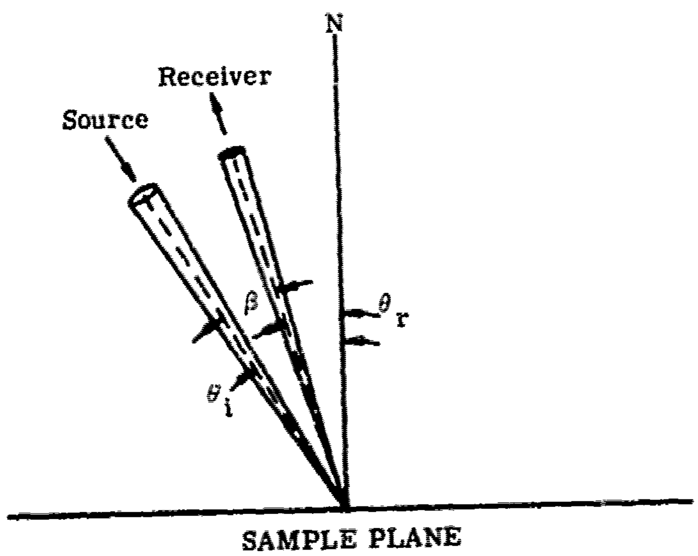

FIGURE E-1. FIXED BISTATIC ANGULAR REPRESENTATION

TABLE E-1. MEASUREMENT SUMMARY OF 10.6 μm BIDIRECTIONAL REFLECTANCE DATA

Description	Sample No.	Area	PCODE	ϕ_r
TRW 2nd Surface Mirror Array	3165	505	2,5	.00 180.00
TRW 2nd Surface Mirror Array	3165	605	2,5	.00 180.00
TRW 2nd Surface Mirror Array	3165	705	2,5	.00 180.00
Aluminum Trim Tape Strips	3177	901	2,5	.00 180.00
Aluminum Trim Tape Strips	3177	902	2,5	90.00 270.00
Solar Cell Array, H-Type	3179	503	2,5	.00 180.00
Solar Cell Array, H-Type	3179	603	2,5	.00 180.00
Solar Cell Array, H-Type	3179	703	2,5	.00 180.00
Solar Cell Array, C-Type	3181	503	2,5	.00
Solar Cell Array, C-type	3181	603	2,5	.00 180.00
Solar Cell Array, C-Type	3181	703	2,5	.00 180.00
Solar Cell Array, H-Type	3182	410	2,5	.0 180.00
Solar Cell Array, H-Type	3182	510	2,5	.00 180.00
Solar Cell Array, H-Type	3182	610	2,5	.00 180.00
Solar Cell Array, H-Type	3183	505	2,5	.00 180.00
Solar Cell Array, H-Type	3183	605	2,5	.00 180.00
Solar Cell Array, H-Type	3183	705	2,5	.00
Solar Cell Array, C-Type	3184	413	2,5	.00 180.00
Solar Cell Array, C-Type	3184	513	2,5	.00 180.00
Solar Cell Array, C-Type	3184	613	2,5	.00 180.00
Solar Cell Array, C-Type	3185	505	2,5	.00 180.00
Solar Cell Array, C-Type	3185	605	2,5	.00 180.00
Solar Cell Array, C-Type	3185	705	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3189	502	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3189	602	2,5	.00 180.00

TABLE E-1. MEASUREMENT SUMMARY OF 10.6 μm BIDIRECTIONAL REFLECTANCE DATA (Concluded)

Description	Sample No.	Area	PCODE	ϕ_r
Aerojet 2nd Surface Mirror Array	3189	702	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	404	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3190	504	2,5	.00
Aerojet 2nd Surface Mirror Array	3190	604	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3194	502	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3194	602	2,5	.00 180.00
Aerojet 2nd Surface Mirror Array	3194	702	2	.00 180.00
3M Black Velvel Paint 101-C10	3197	501	5	.00 180.00
Aerojet White Paint .008-.010 Thick, Telescope Substrate	3206	501	5	.00 180.00
Aerojet White Paint .008-.010 Thick, Telescope Substrate	3207	501	5	.00 180.00

Sample Number
Area Condition Number
Card Type
Run Number
Data Set Number

```
                                                                    λ        β        φi                 φr
A0316550500l      6      94
A03165505510l        TRW SECOND SURFACE MIRROR ARRAY.
A03165505900l   441             7  2    .28    .28     1   10.6   -.26     .00              .00
A03165505921    441      .2835.409
A03165505900l   442             7  2    .0C    .23    11   10.6   -.26180.00               .00
A03165505921    442      .001203.9     .031416.4      .061416.4     .082053.7      .103682.5
A0316550592 2   442      .124390.7     .144674.0      .154390.7     .172832.7      .201416.4
A0316550592 3   442      .23283.27
A03165505900l   443             7  2    .0C    .17     6   10.6    .26180.00            180.00
A0316550592 1   443      .001203.9     .031358.0      .07779.00     .10283.27      .12141.64
A0316550592 2   443      .1735.409
```

FIGURE E-2. EXCERPT FROM DATA TABULATION

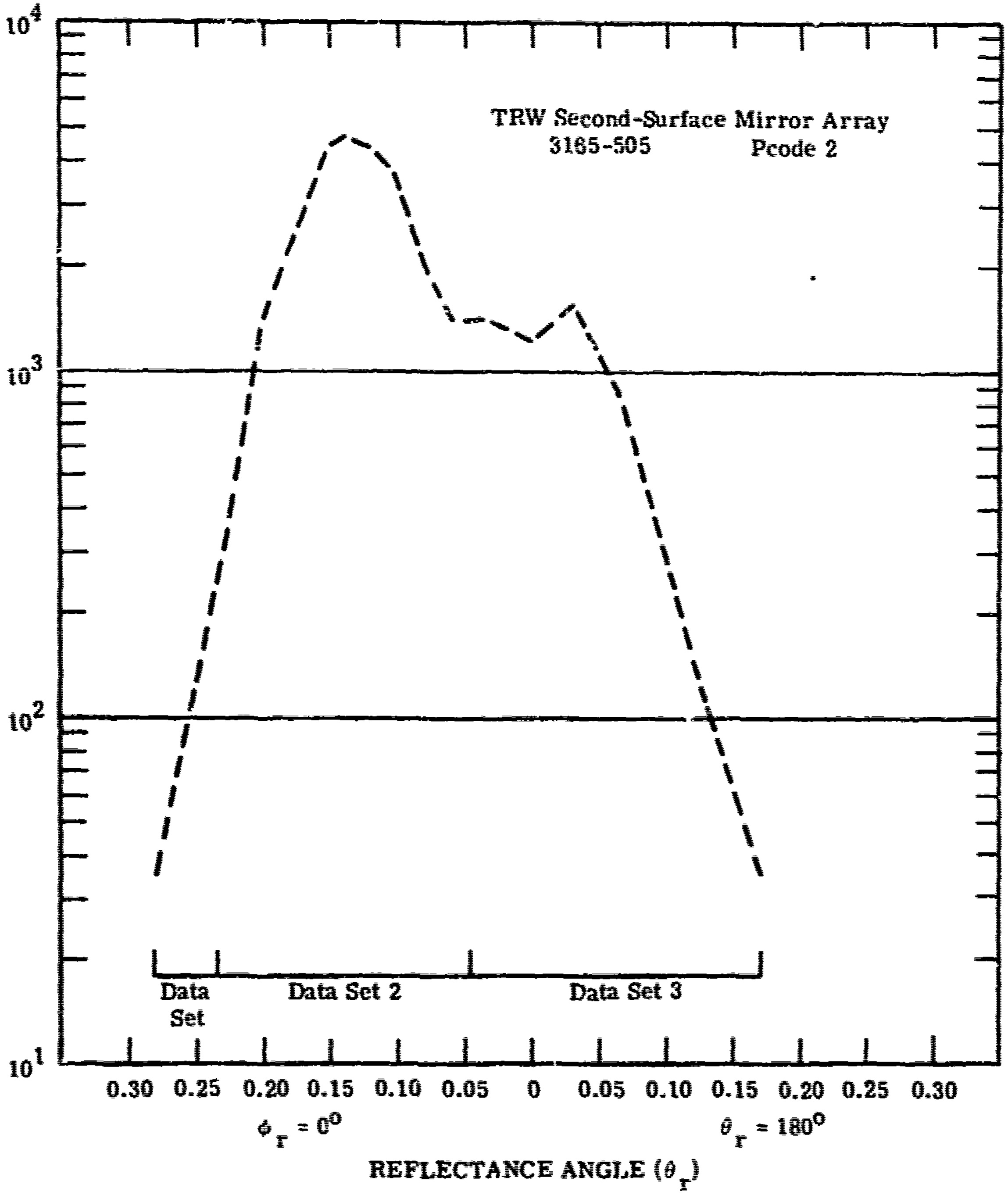

FIGURE E-3. ANALOG PLOT OF TABULATED DATA FROM FIGURE E-2

```
A031655C55001            6      94
A031655C55101         TRW SECOND SURFACE MIRROR ARRAY.
A031655C59001   441         7  2   .28    .28    1   10.6  -.26    .00          .00
A031655C592 1   441      .2835.4C9
A031655C59001   442         7  2   .00    .23   11   10.6  -.26180.00           .00
A031655C592 1   442      .001203.9   .031416.4   .061416.4   .082053.7   .103682.5
A031655C592 2   442      .124390.7   .144674.0   .154390.7   .172832.7   .201416.4
A031655C592 3   442      .23283.27
A031655C59001   443         7  2   .00    .17    6   10.6   .26180.00        180.00
A031655C592 1   443      .001203.9   .031558.C   .07779.0C   .10283.27   .12141.64
A031655C592 2   443      .1735.4C9
A031655C59001   981         7  5   .27    .47    5   10.6  -.26    .00          .00
A031655C592 1   981      .27701.27   .31428.56   .36740.23   .39857.11   .47116.88
A031655C59001   982         7  5   .05    .23   11   10.6  -.26180.00           .00
A031655C592 1   982      .05311.68   .07779.19   .092649.3   .104051.8   .115142.7
A031655C592 2   982      .135766.0   .145298.5   .163428.4   .182649.3   .192610.3
A031655C592 3   982      .23857.11
A031655C59001   983         7  5   .02    .12    2   10.6   .26180.00        180.00
A031655C592 1   983      .02155.84   .1277.919
A031656C55001            5      94
A031656C55101         TRW SECOND SURFACE MIRROR ARRAY.
A031656C59001   452         7  2   .02    .23   14   10.6  -.26180.00           .00
A031656C592 1   452      .02466.70   .05359.00   .081148.8   .101723.2   .112872.0
A031656C592 2   452      .124164.4   .134595.2   .144164.4   .153302.8   .162297.6
A031656C592 3   452      .171005.2   .18287.2C   .20143.60   .2335.900
A031656C59001   453         7  2   .01    .20    6   10.6   .26180.00        180.00
A031656C592 1   453      .01430.80   .051292.4   .09718.00   .12215.40   .1771.800
A031656C592 2   453      .2035.90C
A031656C59001   971         7  5   .20    .33    2   10.6  -.26    .00          .00
A031656C592 1   971      .28156.12   .3378.061
A031656C59001   972         7  5   .03    .23   15   10.6  -.26180.00           .00
A031656C592 1   972      .03585.45   .061209.9   .082029.6   .093200.5   .104371.4
A031656C592 2   972      .115464.2   .126088.7   .136440.0   .146088.7   .154683.6
A031656C592 3   972      .163200.5   .172185.7   .181092.8   .20702.55   .23312.24
A031656C59001   973         7  5   .02    .17    3   10.6   .26180.00        180.00
A031656C592 1   973      .02507.39   .07125.15   .1778.061
A031657C55001            7      94
A031657C55101         TRW SECOND SURFACE MIRROR ARRAY.
A031657C59001   432         7  2   .01    .26   14   10.6  -.26180.00           .00
A031657C592 1   432      .011382.0   .041831.1   .073593.2   .104698.8   .145113.4
A031657C592 2   432      .155528.0   .166219.0   .176149.9   .185113.4   .193455.0
A031657C592 3   432      .202073.0   .21829.20   .24414.60   .26103.65
A031657C59001   433         7  2   .02    .07    3   10.6   .26180.00        180.00
A031657C592 1   433      .02483.70   .04207.30   .0769.100
A031657C59001   952         7  5   .02    .23   11   10.6  -.26180.00           .00
A031657C592 1   952      .022333.3   .043305.6   .053402.8   .094861.1   .103500.0
A031657C592 2   952      .126222.2   .137583.3   .147000.0   .163888.9   .181750.0
A031657C592 3   952      .23388.89
A031657C59001   953         7  5   .02    .04    2   10.6   .26180.00        180.00
A031657C592 1   953      .02583.33   .04388.89
A031657C59001   961         7  5   .26    .26    1   10.6  -.26    .00          .00
A031657C592 1   961      .2695.455
A031657C59001   962         7  5   .03    .26   13   10.6  -.26180.00           .00
A031657C592 1   962      .032863.6   .054200.0   .074009.1   .084200.0   .095345.5
A031657C592 2   962      .119545.5   .1210977.   .1310882.   .149927.3   .164963.6
A031657C592 3   962      .182100.0   .22381.82   .2695.455
A031657C59001   963         7  5   .02    .08    2   10.6   .26180.00        180.00
A031657C592 1   963      .02572.73   .0895.455
A031779C15001            6      94
A031779C15101         ALUMINUM TRIM TAPE STRIPS.
A031779C19001   481         7  2   .26    .93   15   10.6  -.26    .00          .00
```

A0317790192 1	481	.261112.3	.281094.9	.30695.17	.32364.97	.34347.59
A0317790192 2	481	.35382.34	.38312.83	.43347.59	.48139.03	.51104.28
A0317790192 3	481	.55121.66	.6369.517	.7352.138	.8326.069	.938.6897
A031779019001	482	7 2	.02 .26	10 10.6	-.26180.00	.00
A0317790192 1	482	.02590.90	.03616.97	.05538.76	.07590.90	.11408.41
A0317790192 2	482	.16556.14	.18738.62	.20556.14	.24903.72	.261112.3
A031779019001	483	7 2	.01 .67	14 10.6	.26180.00	180.00
A0317790192 1	483	.01677.79	.03556.14	.05347.59	.09486.62	.13243.31
A0317790192 2	483	.17191.17	.22104.28	.27139.03	.3169.517	.35139.03
A0317790192 3	483	.4252.138	.4717.379	.5734.759	.678.6897	
A031779019001	1021	7 5	.27 .98	11 10.6	-.26 .00	.00
A0317790192 1	1021	.27812.23	.29734.88	.33928.26	.36696.20	.38406.12
A0317790192 2	1021	.43232.07	.46135.37	.53193.39	.5858.017	.63116.03
A0317790192 3	1021	.9838.678				
A031779019001	1022	7 5	.02 .23	10 10.6	-.26180.00	.00
A0317790192 1	1022	.021102.3	.06850.91	.111044.3	.121276.4	.141701.8
A0317790192 2	1022	.161624.5	.171353.7	.18928.26	.22638.18	.2?438.18
A031779019001	1023	7 5	.01 .82	11 10.6	.26180.00	180.00
A0317790192 1	1023	.01812.23	.04609.17	.06657.52	.08541.49	.12367.44
A0317790192 2	[illegible]	.17367.44	.23580.17	.27406.12	.37193.39	.5758.017
A0317790192 3	1023	.8219.339				
A031779025001		5 94				
A031779025101		ALUMINUM TRIM TAPE STRIPS.				
A031779029001	491	7 2	.26 1.83	25 10.6	-.26 90.00	90.00
A0317790292 1	491	.26417.10	.28364.97	.32538.76	.33625.66	.38712.55
A0317790292 2	491	.43769.03	.46573.52	.48347.59	.53330.21	.56295.45
A0317790292 3	491	.58347.59	.63547.45	.65434.48	.68295.45	.74252.00
A0317790292 4	491	.73295.45	.76278.07	.78208.55	.80130.34	.9387.766
A0317790292 5	491	1.0886.897	1.2852.138	1.3834.759	1.6317.379	1.838.6897
A031779029001	492	7 2	.01 .26	11 10.6	-.26270.00	90.00
A0317790292 1	492	.01543.10	.03495.31	.08599.59	.09451.86	.12304.14
A0317790292 2	492	.16399.72	.18269.38	.20356.28	.23434.48	.25469.24
A0317790292 3	492	.26417.10				
A031779029001	493	7 2	.02 1.17	30 10.6	.26270.00	270.00
A0317790292 1	493	.02399.72	.05338.90	.08399.72	.37278.07	.1520[illegible]
A0317790292 2	493	.17347.59	.21582.21	.22538.76	.23521.38	.2559[illegible]
A0317790292 3	493	.27469.24	.30312.83	.33243.31	.35330.21	.37451.86
A0317790292 4	493	.40295.45	.42147.72	.47182.48	.52252.00	.57173.79
A0317790292 5	493	.62121.66	.67104.28	.72147.72	.77191.17	.82130.34
A0317790292 6	493	.8795.586	.9295.586	.9778.207	1.0721.724	1.1717.379
A031779029001	1011	7 5	1.03 1.53	6 10.6	-.26 90.00	90.0[illegible]
A0317790292 1	1011	1.03243.22	1.08162.15	1.13364.83	1.28222.95	1.38182.[illegible]
A0317790292 2	1011	1.5381.074				
A031779029001	1013	7 5	.72 .92	49 10.6	.26270.00	270.00
A0317790292 1	1013	.72263.49	.93405.37	.86385.10	.83608.06	.78587.79
A0317790292 2	1013	.74486.45	.72729.67	.681013.4	.65709.40	.581013.4
A0317790292 3	1013	.551175.6	.52932.36	.49770.21	.48993.16	.451114.8
A0317790292 4	1013	.43891.82	.39628.33	.36891.82	.341054.0	.31749.94
A0317790292 5	1013	.301013.4	.281216.1	.23932.36	.18790.48	.171013.4
A0317790292 6	1013	.161499.9	.151986.3	.111418.8	.09891.82	.07993.16
A0317790292 7	1013	.04993.16	.001155.3	.02831.01	.05445.91	.10709.40
A0317790292 8	1013	.13770.21	.18810.74	.21648.60	.24668.86	.26770.21
A0317790292 9	1013	.30689.13	.32608.06	.35405.37	.40466.18	.55162.15
A031779029210	1013	.60304.03	.77121.61	.87131.75	.9260.806	
A031795035001		6 94				
A031795035101		SOLAR CELL ARRAY, H-TYPE.				
A031795039001	61	7 2	.26 .43	5 10.6	-.26 .00	.00
A0317950392 1	61	.26776.16	.28701.53	.33388.08	.3889.557	.4314.926
A031795039001	62	7 2	.00 .26	8 10.6	-.26180.00	.00
A0317950392 1	62	.001358.3	.031223.9	.051253.8	.081164.2	.131000.0
A0317950392 2	62	.18820.94	.23761.23	.26776.16		

A031795C39001	63	7 2	.00 .12	4 10.6	.26180.00	180.00
A031795C392 1	63	.001358.3	.021298.6	.07208.97	.1229.852	
A031795C39001	581	7 5	.26 .43	5 10.6	-.26 .00	.00
A031795C392 1	581	.26633.66	.30697.03	.33591.42	.3884.489	.43.00000
A031795C39001	582	7 5	.01 .26	9 10.6	-.26180.00	.00
A031795C392 1	582	.01337.95	.03675.91	.041013.9	.051309.6	.081816.5
A031795C392 2	582	.131351.8	.181056.1	.23802.64	.26633.66	
A031795C39001	583	7 5	.02 .02	1 10.6	.26180.00	180.00
A031795C392 1	583	.0263.366				
A031796C35001		3 94				
A031796C35101		SOLAR CELL ARRAY, H-TYPE.				
A031796C39001	72	7 2	.03 .23	13 10.6	-.26180.00	.00
A031796C392 1	72	.0358.522	.08497.44	.09673.00	.10819.31	.11994.88
A031796C392 2	72	.121170.4	.131316.7	.141404.5	.151287.5	.161082.7
A031796C392 3	72	.17775.42	.18585.22	.237.3153		
A031796C39001	73	7 2	.02 .02	1 10.6	.26180.00	180.00
A031796C392 1	73	.0214.631				
A031796C39001	592	7 5	.03 .18	12 10.6	-.26180.00	.00
A031796C392 1	592	.03108.97	.08544.83	.09871.73	.102397.3	.114358.7
A031796C392 2	592	.127191.8	.138281.5	.148499.4	.156755.9	.162615.2
A031796C392 3	592	.17435.87	.18217.93			
A031797C35001		6 94				
A031797C35101		SOLAR CELL ARRAY, H-TYPE.				
A031797C39001	81	7 2	.28 .33	2 10.6	-.26 .00	.00
A031797C392 1	81	.28886.70	.33147.78			
A031797C39001	82	7 2	.01 .25	12 10.6	-.26180.00	.00
A031797C392 1	82	.012216.7	.032807.9	.053103.4	.082536.2	.102438.4
A031797C392 2	82	.122512.3	.132438.4	.162364.5	.182586.2	.203251.2
A031797C392 3	82	.234137.9	.253103.4			
A031797C39001	83	7 2	.02 .12	3 10.6	.26180.00	180.00
A031797C392 1	83	.021182.3	.07221.67	.1273.892		
A031797C39001	601	7 5	.28 .33	2 10.6	-.26 .00	.00
A031797C392 1	601	.28304.00	.3343.429			
A031797C39001	602	7 5	.00 .24	12 10.6	-.26180.00	.00
A031797C392 1	602	.001563.4	.032779.4	.043908.6	.083300.6	.092909.7
A031797C392 2	602	.103300.6	.133387.4	.152953.1	.183474.3	.224338.5
A031797C392 3	602	.233387.4	.242171.4			
A031797C39001	603	7 5	.00 .12	4 10.6	.26180.00	180.00
A031797C392 1	603	.001563.4	.02608.00	.0743.429	.1221.714	
A031815C35001		2 94				
A031815C35101		SOLAR CELL ARRAY, C-TYPE.				
A031815C39001	22	7 2	.06 .23	13 10.6	-.26180.00	.00
A031815C392 1	22	.0670.826	.08212.48	.09849.91	.102124.8	.113541.3
A031815C392 2	22	.125524.4	.136161.8	.145666.1	.154249.5	.163116.3
A031815C392 3	22	.172124.8	.18991.56	.23134.57		
A031815C39001	532	7 5	.03 .23	13 10.6	-.26180.00	.00
A031815C392 1	532	.0359.012	.08354.07	.091180.2	.102596.5	.114957.0
A031815C392 2	532	.126845.4	.138261.7	.148379.7	.155429.1	.163304.7
A031815C392 3	532	.17944.19	.18531.11	.23118.02		
A031816C35001		6 94				
A031816C35101		SOLAR CELL ARRAY, C-TYPE.				
A031816C39001	31	7 2	.28 .48	5 10.6	-.26 .00	.00
A031816C392 1	31	.281014.4	.33920.18	.38492.70	.43101.44	.4814.491
A031816C39001	32	7 2	.03 .23	5 10.6	-.26180.00	.00
A031816C392 1	32	.03999.88	.081043.4	.131101.3	.181123.1	.231043.4
A031816C39001	33	7 2	.02 .27	8 10.6	.26180.00	180.00
A031816C392 1	33	.02854.97	.06652.10	.08695.57	.10724.55	.12637.61
A031816C392 2	33	.17231.86	.2272.455	.2721.737		
A031816C39001	541	7 5	.28 .48	6 10.6	-.26 .00	.00
A031816C392 1	541	.28858.65	.33768.27	.37474.52	.38542.30	.43112.98
A031816C392 2	541	.4833.894				

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A031816C390C1  542          7  5    .00    .23   9   10.6  -.26180.C0        .00
A031816C392 1  542     .001129.8   .021265.4   .041220.2   .071446.1   .091446.1
A031816C392 2  542     .121468.7   .151513.9   .181401.C   .23994.23
A031816C39001  543          7  5    .00    .27   9   10.6   .26180.C0     180.00
A031816C392 1  543     .001129.8   .02994.23   .04869.95   .071005.5   .09471.63
A031816C392 2  543     .12542.30   .17124.28   .2245.192   .2722.596
A031817C350C1               9      94
A031817C35101          SOLAR CELL ARRAY, C-TYPE.
A031817C390C1   11          7  2    .28    .43   3   10.6  -.26    .C0        .00
A031817C392 1   11     .28403.64   .3386.495   .4314.416
A031817C390C1   12          7  2    .03    .23  1C   10.6  -.26180.C0        .00
A031817C392 1   12     .031095.6   .081499.2   .101643.4   .111701.1   .121729.9
A031817C392 2   12     .131672.2   .181383.9   .191268.6   .211239.8   .231205.2
A03181703900l   13          7  2    .02    .17   6   10.6   .26180.00     180.00
A031817C392 1   13     .02634.30   .04634.30   .06605.47   .07576.63   .12201.82
A0318170392 2   13     .1757.663
A031817C390C1  511          7  2    .28    .38   3   10.6  -.26    .00        .00
A031817C392 1  511     .28554.46   .3373.929   .3818.482
A031817C390C1  512          7  2    .03    .25   9   10.6  -.26180.C0        .00
A031817C392 1  512     .031182.9   .071589.5   .1C1811.3   .121848.2   .141792.8
A031817C392 2  512     .161663.4   .201349.2   .221367.7   .251072.0
A031817C390C1  513          7  2    .02    .22   6   10.6   .26180.00     180.00
A031817C392 1  513     .02739.29   .05720.8C   .09480.54   .12221.79   .15110.89
A031817C392 2  513     .22.000C0
A031817C39001  521          7  5    .28    .43   4   10.6  -.26    .00        .00
A031817C392 1  521     .28610.58   .33234.84   .3870.451   .43.00000
A031817C39001  522          7  5    .01    .23   6   10.6  -.26180.00        .00
A031817C392 1  522     .011127.2   .031C33.3   .081409.C   .131878.7   .182113.5
A0318170392 2  522     .231409.C
A031817C39001  523          7  5    .02    .22   5   10.6   .26180.C0     180.00
A031817C392 1  523     .02915.87   .073C5.29   .1293.935   .1723.484   .2211.742
A03182410500l               5      94
A031824105lC1          SOLAR CELL ARRAY, H-TYPE.
A03182410900l  262          7  2    .01    .26   9   10.6  -.26180.C0        .00
A0318241092 1  262     .01740.77   .06875.45   .101010.1   .141279.5   .181734.1
A0318241092 2  262     .191582.6   .21824.95   .23134.69   .26.00C00
A031824109001  263          7  2    .02    .16   5   10.6   .26180.00     180.00
A0318241092 1  263     .02606.08   .06774.44   .10404.06   .1467.343   .16.00000
A031824109001  801          7  5    .26    .28   2   10.6  -.26    .00        .00
A0318241092 1  801     .26182.74   .2891.371
A031824109001  802          7  5    .03    .26   8   10.6  -.26180.00        .00
A0318241092 1  802     .031096.4   .08137C.6   .151736.C   .182352.8   .192329.9
A0318241092 2  802     .221461.9   .231C05.1   .26182.74
A031824109OC1  803          7  5    .03    .22   5   10.6   .26180.00     180.00
A0318241092 1  803     .03822.34   .08868.C2   .12548.22   .17137.06   .2291.371
A031825105OC1               6      94
A031825105lC1          SOLAR CELL ARRAY, H-TYPE.
A031825109001  251          7  2    .28    .93  15   10.6  -.26    .00        .00
A0318251092 1  251     .28538.74   .33526.11   .38696.65   .43454.56   .48416.68
A0318251092 2  251     .52349.34   .55361.97   .58294.62   .62235.70   .66239.91
A0318251092 3  251     .73134.69   .7858.925   .8305.253   .8816.836   .938.4178
A031825109001  252          7  2    .03    .23   5   10.6  -.26180.00        .00
A0318251092 1  252     .03521.91   .08538.74   .13555.58   .18551.37   .23542.95
A031825109OC1  253          7  2    .02    .52  12   10.6   .26180.00     180.00
A0318251092 1  253     .02479.82   .07420.89   .12353.55   .17349.34   .22235.70
A0318251092 2  253     .26277.79   .29311.46   .32282.30   .37117.95   .4242.089
A0318251092 3  253     .4716.836   .528.4178
A031825109001  791          7  5    .28    .78   6   10.6  -.26    .00        .00
A0318251092 1  791     .28523.63   .38364.26   .48227.66   .58102.45   .6845.533
A0318251092 2  791     .7822.766
A031825109001  792          7  5    .08    .18   2   10.6  -.26180.00        .00
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A0318251092 1   792      .08648.85   .18626.C8
A031825109001   793           7  5   .02    .47  1C   10.6   .26180.00      180.00
A0318251092 1   793      .02535.01   .12387.03   .15318.73   .19387.03   .22387.03
A0318251092 2   793      .24352.88   .27250.43   .32113.83   .3745.533   .4711.383
A031826105001              6      94
A031826105101          SOLAR CELL ARRAY, H-TYPE.
A031826109001   241           7  2   .28    .53   8   10.6  -.26   .00          .00
A0318261092 1   241      .231000.7   .33917.31   .38833.92   .43633.78   .48466.99
A0318261092 2   241      .53200.14   .5858.374   .63.00000
A031826109001   242           7  2   .03    .23   5   10.6  -.26180.00          .00
A0318261092 1   242      .03867.27   .08967.34   .131017.4   .181034.1   .231017.4
A031826109001   243           7  2   .02    .42   9   10.6   .26180.00      180.00
A0318261092 1   243      .02750.52   .07633.78   .12483.67   .17567.06   .22433.64
A0318261092 2   243      .27183.46   .3250.035   .378.3392   .42.00000
A031826109001   781           7  5   .28    .63   6   10.6  -.26   .00          .00
A0318261092 1   781      .28815.48   .33679.57   .38407.74   .43283.15   .5345.305
A0318261092 2   781      .6322.652
A031826109001   782           7  5   .03    .23   5   10.6  -.26180.00          .00
A0318261092 1   782      .031110.0   .081291.2   .121336.5   .181200.6   .23974.05
A031826109001   783           7  5   .02    .42   9   10.6   .26180.00      180.00
A0318261092 1   783      .02838.13   .07679.57   .11543.65   .14611.61   .17543.65
A0318261092 2   783      .22271.83   .2790.609   .3233.978   .4211.326
A031835C55001              6      94
A031835C55101          SOLAR CELL ARRAY, H-TYPE.
A031835C59001   101           7  2   .28    .33   2   10.6  -.26   .00          .00
A031835C592 1   101      .2864.286   .3332.143
A031835C59001   102           7  2   .03    .23   9   10.6  -.26180.00          .00
A031835C592 1   102      .031382.1   .081864.3   .132442.9   .152635.7   .172780.4
A031835C592 2   102      .182667.9   .202185.7   .211478.6   .23707.14
A031835C59001   103           7  2   .02    .27   6   10.6   .26180.00      180.00
A031835C592 1   103      .021157.1   .07964.29   .12996.43   .17514.29   .2296.429
A031835C592 2   103      .2732.143
A031835C59001   631           7  5   .26    .38   4   10.6  -.26   .00          .00
A031835C592 1   631      .262293.9   .281529.3   .3347.790   .38.00000
A031835C59001   632           7  5   .00    .26   8   10.6  -.26180.00 .        .00
A031835C592 1   632      .001720.4   .032126.6   .071911.6   .102055.0   .132055.0
A031835C592 2   632      .182341.7   .242509.0   .262293.9
A031835C59001   633           7  5   .00    .12   4   10.6   .26180.00      180.00
A031835C592 1   633      .001720.4   .021027.5   .0747.790   .12.00000
A031836C55001              4      94
A031836C55101          SOLAR CELL ARRAY, H-TYPE.
A031836C59001   122           7  2   .03    .26   8   10.6  -.26180.00          .00
A031836C592 1   122      .031432.0   .092704.8   .123977.7   .154773.2   .164136.8
A031836C592 2   122      .182227.5   .21236.66   .26.00000
A031836C59001   123           7  2   .02    .14   4   10.6   .26180.00      180.00
A031836C592 1   123      .02994.42   .041113.8   .09397.77   .1439.777
A031836C59001   652           7  5   .03    .22   7   10.6  -.26180.00          .00
A031836C592 1   652      .031808.1   .093013.5   .145002.5   .164580.6   .183134.1
A031836C592 2   652      .201205.4   .22241.08
A031836C59001   653           7  5   .02    .23   4   10.6   .26180.00      180.00
A031836C592 1   653      .021205.4   .071024.6   .14964.33   .2360.271
A031837C55001              2      94
A031837C55101          SOLAR CELL ARRAY, H-TYPE.
A031837C59001   132           7  2   .03    .23  11   10.6  -.26180.00          .00
A031837C592 1   132      .0337.875   .08606.00   .091816.0   .103030.0   .114696.5
A031837C592 2   132      .126060.0   .136817.5   .154545.0   .163030.0   .18909.00
A031837C592 3   132      .231.3.63
A031837C59001   662           7  5   .03    .23  13   10.6  -.26180.00          .00
A031837C592 1   662      .03119.47   .081433.7   .093345.3   .105495.8   .118602.2
A031837C592 2   662      .1210275.   .1310872.   .1410275.   .158124.3   .164779.0
A031837C592 3   662      .172150.5   .181194.7   .23179.21
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A031844135001              6      94
A031844135101           SOLAR CELL ARRAY, C-TYPE.
A031844139001  191            7  2   .26   .43   5   10.6  -.26   .00          .00
A0318441392 1  191      .261278.9   .31456.74   .36121.80   .4130.449   .43.00000
A031844139001  192            7  2   .00   .26  11   10.6  -.26180.00          .00
A0318441392 1  192      .001339.8   .031492.C   .081613.8   .101796.5   .122161.9
A0318441392 2  192      .142253.2   .152527.3   .182344.6   .201766.C   .231552.9
A0318441392 3  192      .261278.9
A031844139001  193            7  2   .00   .2C   9   10.6   .26180.C0        18C.00
A0318441392 1  193      .001339.8   .031C96.2   .05989.59   .07102C.0   .09959.14
A0318441392 2  193      .11578.53   .14243.59   .1730.449   .20.00000
A031844139001  731            7  5   .28   .48   4   10.6  -.26   .00          .00
A0318441392 1  731      .28873.8C   .31349.52   .3887.38C   .4843.690
A031844139001  732            7  5   .02   .24   8   10.6  -.26180.C0          .00
A0318441392 1  732      .021419.9   .072271.9   .102883.5   .143058.3   .152970.9
A0318441392 2  732      .182359.3   .221616.5   .241572.8
A031844139001  733            7  5   .02   .22   5   10.6   .26180.00        18C.00
A0318441392 1  733      .021332.5   .06699.C4   .11174.76   .1697.38C   .2243.690
A031845135001              6      94
A031845135101           SOLAR CELL ARRAY, C-TYPE.
A0318451390C1  201            7  2   .26   .36   4   10.6  -.26   .00          .00
A0318451392 1  201      .26409.46   .28386.71   .3360.66C   .36.0000C
A031845139001  202            7  2   .02   .26   8   10.6  -.26180.C0          .00
A0318451392 1  2C2      .02333.63   .046C6.60   .07962.98   .09985.73   .131175.3
A0318451392 2  202      .18887.15   .23545.94   .26409.46
A031845139001  203            7  2   .02   .C7   3   10.6   .26180.00        180.00
A0318451392 1  203      .0260.680   .0415.165   .07.00000
A031845139001  741            7  5   .27   .43   6   10.6  -.26   .00          .00
A0318451392 1  741      .272483.5   .291432.8   .32573.11   .35191.04   .3895.518
A0318451392 2  741      .4347.759
A0318( :39001  742            7  5   .03   .25   6   10.6  -.26180.00          .00
A0318451392 1  742      .031862.6   .082125.3   .132626.8   .173128.2   .063104.3
A0318451392 2  742      .253056.6
A031845139001  743            7  5   .02   .17   5   10.6   .26180.00        180.00
A0318451392 1  743      .021719.3   .041237.3   .07668.63   .12143.28   .1747.759
A031846135001              4      94
A031846135101           SOLAR CELL ARRAY, C-TYPE.
A031846139001  212            7  2   .03   .23  16   10.6  - 26180.00          .0G
A0318461392 1  212      .0387.232   .06261.76   .07698.02   .081221.5   .091745.0
A0318461392 2  212      .102792.1   .114537.1   .127503.7   .139074.3   .148376.2
A0318461392 3  212      .156980.2   .164537.1   .172443.1   .18693.02   .20174.50
A0318461392 4  212      .23.000C0
A031846139001  751            7  5   .28   .28   1   10.6  -.26   .00          .00
A0318461392 1  751      .28277.19
A0318461390C1  752            7  5   .03   .20  14   10.6  -.26180.00          .00
A0318461392 1  752      .03554.38   .061108.8   .082217.5   .093880.7   .108315.7
A0318461392 2  752      .1112474.   .1214968.   .1316354.   .1415523.   .1514414.
A0318461392 3  752      .169978.9   .177207.0   .181663.1   .20554.38
A0318461390C1  753            7  5   .07   .C7   1   10.6   .26180.00        180.00
A0318461392 1  753      .07277.19
A031855C55001              5      94
A031855055101           SLLAR CELL ARRAY, C-TYPE.
A031855C590C1  151            7  2   .27   .4C   7   10.6  -.26   .00          .00
A031855C592 1  151      .271030.7   .281C38.6   .30951.43   .31792.86   .32570.86
A031855C592 2  1C1      .3663.429   .40.000C0
A031855059001  152            7  2   .01   .24   9   10.6  -.26180.00          .00
A031855C592 1  152      .01515.36   .04570.86   .06697.71   .07681.86   .10729.43
A031855C592 2  152      .16856.29   .18888.C0   .201014.9   .241141.7
A031855C59001  153            7  2   .02   .20   6   10.6   .26180.00        180.00
A0318550592 1  153      .02618.43   .04570.86   .07317.14   .1287.214   .1723.786
A031855C592 2  153      .207.9286
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AO31855C590C1	682	7 5	.04 .26	10 10.6	-.26180.00	.00
AO31855C592 1	682	.041213.5	.081650.4	.102014.4	.122087.2	.142038.7
AO31855C592 2	682	.162232.8	.181941.6	.201116.4	.23291.24	.2648.540
AO31855C590C1	683	7 5	.03 .27	5 10.6	.26180.00	180.00
AO31855C592 1	683	.03679.56	.10509.67	.12388.32	.17388.32	.2748.540
AO31856C55001		6 94				
AO31856C551C1		SOLAR CELL ARRAY, C-TYPE.				
AO31856C590C1	161	7 2	.27 .52	8 10.6	-.26 .00	.00
AO31856C592 1	161	.27452.18	.29347.83	.34463.78	.37386.48	.40247.35
AO31856C592 2	161	.42154.59	.4723.189	.52.00000		
AO31856C590C1	162	7 2	.01 .21	5 10.6	-.26180.00	.00
AO31856C592 1	162	.01386.48	.06432.86	.11471.51	.16494.69	.21475.37
AO31856C590C1	163	7 2	.04 .42	9 10.6	.26180.00	180.00
AO31856C592 1	163	.04332.37	.10278.27	.14235.75	.16239.62	.21154.59
AO31856C592 2	163	.26185.51	.3277.296	.3715.459	.427.7296	
AO31856C590C1	691	7 5	.28 .63	9 10.6	-.26 .00	.00
AO31856C592 1	691	.28587.50	.33526.30	.38440.63	.43318.23	.45348.83
AO31856C592 2	691	.48305.99	.53122.40	.5836.719	.6318.359	
AO31856C590C1	692	7 5	.03 .23	5 10.6	-.26180.00	.00
AO31856C592 1	692	.03501.82	.08538.54	.13575.26	.18611.98	.23636.46
AO31856C590C1	693	7 5	.02 .47	10 10.6	.26180.00	180.00
AO31856C592 1	693	.02477.35	.05422.27	.08446.75	.13318.23	.18367.19
AO31856C592 2	693	.22293.75	.27134.64	.3248.959	.3724.479	.4712.240
AO31857C550C1		5 94				
AO31857C551C1		SOLAR CELL ARRAY, C-TYPE.				
AO31857C590C1	172	7 2	.03 .21	9 10.6	-.26180.00	.00
AO31857C592 1	172	.031873.5	.051834.4	.092654.1	.113903.1	.145269.1
AO31857C592 2	172	.163903.1	.173122.4	.181717.3	.21156.12	
AO31857C590C1	173	7 2	.02 .12	3 10.6	.26180.00	180.00
AO31857C592 1	173	.02936.73	.07156.12	.1239.031		
AO31857C590C1	701	7 5	.28 .28	1 10.6	-.26 .00	.00
AO31857C592 1	701	.28123.44				
AO31857C590C1	702	7 5	.00 .21	12 10.6	-.26180.00	.00
AO31857C592 1	702	.002222.0	.022345.4	.042222.0	.052222.0	.093519.8
AO31857C592 2	702	.126048.7	.136789.3	.146542.4	.155925.2	.173209.5
AO31857C592 3	702	.19864.10	.21246.88			
AO31857C590C1	703	7 5	.00 .17	5 10.6	.26180.00	180.00
AO31857C592 1	703	.002222.0	.021604.8	.07370.33	.12185.16	.17123.44
AO31895C250C1		5 94				
AO31895C251C1		AEROJET SECOND SURFACE MIRROR ARRAY.				
AO31895C290C1	281	7 2	.28 .28	1 10.6	-.26 .00	.00
AO31895C292 1	281	.2840.400				
AO31895C290C1	282	7 2	.01 .25	14 10.6	-.26180.00	.00
AO31895C292 1	282	.01161.60	.04404.00	.06969.60	.082222.0	.103393.6
AO31895C292 2	282	.113959.2	.124201.6	.134403.6	.144363.2	.154201.6
AO31895C292 3	282	.163959.2	.182585.6	.201616.0	.25242.40	
AO31895C290C1	283	7 2	.02 .02	1 10.6	.26180.00	180.00
AO31895C292 1	283	.0240.400				
AO31895C290C1	822	7 5	.03 .21	11 10.6	-.26180.00	.00
AO31895C292 1	822	.032846.1	.088538.3	.1011100.	.1111384.	.1315369.
AO31895C292 2	822	.1417361.	.1517077.	.1713097.	.188538.3	.194553.8
AO31895C292 3	822	.21569.22				
AO31895C290C1	823	7 5	.00 .00	1 10.6	.26180.00	180.00
AO31895C292 1	823	.00569.22				
AO31896C250C1		4 94				
AO31896C251C1		AEROJET SECOND SURFACE MIRROR ARRAY.				
AO31896C290C1	292	7 2	.03 .22	14 10.6	-.26180.00	.00
AO31896C292 1	292	.03385.60	.05771.20	.083856.0	.108097.6	.1110797.
AO31896C292 2	292	.1212725.	.1313689.	.1413110.	.1511954.	.1610026.
AO31896C292 3	292	.176169.6	.181928.0	.19385.60	.22.00000	
AO31896C290C1	293	7 2	.02 .02	1 10.6	.26180.00	180.00

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A031896C292 1  293      .02192.80
A031896C290C1  832           7  5    .03   .2C  13   10.6  -.26180.00          .00
A031896C292 1  832      .03705.65    .051693.5   .075645.2   .089032.3    .0911855.
A031896C292 2  832      .1115242.    .1216935.   .1317500.   .1416935.    .1612419.
A031896C292 3  832      .178750.C    .193387.1   .20564.52
A031896C290C1  833           7  5    .02   .C2   1   10.6   .26180.00       180.00
A031896C292 1  833      .02423.39
A031897C250C1                3      94
A031897C251C1         AEROJET SECCNC SURFACE MIRROR ARRAY.
A031897C290C1  302           7  2    .03   .21  14   10.6  -.26180.00          .00
A031897C292 1  302       93198.CC    .06396.CC   .07792.0C   .08198C.0    .093564.0
A031897C292 2  302      .114756.0    .126336.C   .138514.0   .148316.0    .157128.0
A031897C292 3  302      . 64356.0    .172376.C   .18396.0C   .21.00000
A031897C290C1  842           7  5    .03   .22  12   10.6  -.26180.C0          .00
A031897C292 1  842      .031693.5    .063951.6   .097903.2   .1111855.    .1215242.
A031897C292 2  842      .1316935.    .1415242.   .1512137.   .168467.7    .183669.4
A031897C292 3  842      .20564.52    .22282.26
A031897C29001  843           7  5    .01   .07   2   10.6   .26180.00       180.00
A031897C292 1  843      .01564.52    .07423.39
A031904C450C1                3      94
A031904C45101         AEROJET SECCNC SURFACE MIRROR ARRAY.
A031904C49001  352           7  2    .01   .25  18   10.6  -.26180.C0          .00
A0319C4C492 1  352      .01125.74    .03335.32   .04838.29   .062850.2    .074023.6
A031904C492 2  352      .096035.7    .106622.5   .116454.9   .126203.4    .135868.0
A0319C4C492 3  352      .156161.5    .166329.1   .176161.5   .185868.0    .203688.5
A031904C492 4  352      .212514.9    .23838.29   .25167.66
A031904C49001  852           7  5    .01   .26  14   10.6  -.26180.00          .00
A031904C492 1  852      .01235.33    .04753.C5   .062635.7   .085083.1    .106777.4
A031904C492 2  852      .117154.0    .126965.7   .145836.1   .155553.7    .165459.6
A031904C492 3  852      .194141.8    .212070.9   .24376.52   .26141.20
A031904C49001  853           7  5    .07   .07   1   10.6   .26180.00       180.00
A031904C492 1  853      .07141.20
A031905C45001                2      94
A031905C45101         AEROJET SECCNC SURFACE MIRROR ARRAY.
A031905C49001  362           7  2    .01   .22  17   10.6  -.26180.00          .00
A0319C5C492 1  362      .01102.44    .032C4.88   .05614.63   .071639.0    .084507.3
A0319C5C492 2  362      .096965.9    .1C1C244.   .1113932.   .1215571.    .1317415.
A0319C5C492 3  362      .1415161.    .1511473.   .168809.8   .176146.3    .182458.5
A0319C5C492 4  362      .191229.3    .22.COCCC
A031905C49001  862           7  5    .03   .22  16   10.6  -.26180.00          .00
A031905C492 1  862      .03462.68    .06925.36   .072313.4   .086014.8    .099253.6
A031905C492 2  862      .1011567.    .1113880.   .1215500.   .1316656.    .1416194.
A031905C492 3  862      .151388C.    .1611104.   .178328.2   .186477.5    .193470.1
A031905C492 4  862      .22462.68
A0319C6C45001                4      94
A031906C45101         AEROJET SECCND SURFACE MIRROR ARRAY.
A0319C6C49001  371           7  2    .28   .33   2   10.6  -.26    .00             .00
A031906C492 1  371      .2841.744    .33.COCCC
A031906C490C1  372           7  2    .01   .23  11   10.6  -.26180.C0          .00
A031906C492 1  372      .0183.488    .055C0.93   .101419.3   .122734.2    .132796.8
AC31906C492 2  372      .142755.1    .152421.1   .162C03.7   .181252.3    .20500.93
A0319C6C492 3  372      .23187.85
A031906C490C1  373           7  2    .05   .05   1   10.6   .26180.00       180.00
A031906C492 1  373      .0520.872
A031906C49001  882           7  5    .03   .18  13   10.6  -.26180.00          .00
A031906C492 1  882      .03227.35    .05454.7C   .081136.8   .092273.5    .105911.1
A0319C6C492 2  882      .118639.3    .1211368.   .1312618.   .1410003.    .155911.1
A031906C492 3  882      .162728.2    .17795.73   .18227.35
A031945C25001                6      94
A031945C25101         AEROJET SECCNC SURFACE MIRROR ARRAY.
A031945C290C1  381           7  2    .27   .43   6   10.6  -.26    .00             .00
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A031945C292 1   381      .27336.46    .29316.67    .31217.71    .3498.958    .3819.792
A031945C292 2   381      .439.8958
A031945C290C1   382            7  2   .01    .24   8    10.6   -.26180.00          .00
A031945C292 1   382      .01395.83    .03326.56    .06376.04    .10430.47    .14371.09
A031945C292 2   382      .18272.14    .21257.29    .24247.40
A031945C290C1   383            7  2   .01    .10   5    10.6    .26180.00       180.00
A031945C292 1   383      .01455.21    .03296.87    .05138.54    .0739.583    .10.00000
A031945C290C1  1C61            7  5   .28    .43   4    10.6   -.26    .00         .00
A031945C292 1  1C61      .28277.29    .3342.66C    .3621.330    .4310.665
A031945C290C1  1C62            7  5   .01    .23  1C    10.6   -.26180.00          .00
A031945C292 1  1C62      .01223.96    .03458.59    .04639.90    .07895.86    .10725.22
A031945C292 2  1C62      .11607.90    .13746.55    .16682.56    .18639.90    .23458.59
A031945C290C1  1C63            7  5   .02    .17   3    10.6    .26180.00       180.00
A031945C292 1  1C63      .0263.99C    .0621.33C    .1710.665
A031946C250C1                 6      94
A031946C251C1          AEROJET SECCNC SURFACE MIRRCR ARRAY.
A031946C29001   391            7  2   .26    .63  1C    10.6   -.26    .00         .00
A031946C292 1   391      .26180.6C    .31211.03    .35215.09    .38194.80    .41170.45
A031946C292 2   391      .46190.74    .48129.87    .5340.583    .5816.233    .634.0583
A031946C290C1   392            7  2   .01    .26   6    10.6   -.26180.00          .00
A031946C292 1   392      .01344.96    .08292.20    .13275.97    .18235.39    .23186.68
A031946C292 2   392      .26180.6C
A031946C29001   393            7  2   .02    .21   8    10.6    .26180.00       180.00
A031946C292 1   393      .02284.C8    .04229.30    .07235.38    .09178.57    .1297.400
A031946C292 2   393      .1440.583    .1716.233    .21.C0C00
A031946C290C1   921            7  5   .26    .32   5    10.6   -.26    .C0         .00
A031946C292 1   921      .261520.3    .27971.32    .28506.77    .30168.92    .3242.231
A031946C290C1   922            7  5   .00    .26  11    10.6   -.26180.00          .00
A031946C292 1   922      .001140.2    .031182.5    .061224.7    .091129.7    .101235.3
A031946C292 2   922      .161330.3    .171478.1    .2C1773.7    .221953.2    .231858.2
A031946C292 3   922      .261520.3
A031946C290C1   923            7  5   .00    .22   6    10.6    .26180.00       180.00
A031946C292 1   923      .001140.2    .01971.32    .03633.47    .07126.69    .1042.231
A031946C292 2   923      .2221.116
A031947C250C1                 3      94
A031947C251C1          AEROJET SECCNC SURFACE MIRRCR ARRAY.
A031947C290C1   401            7  2   .26    .48   9    10.6   -.26    .00         .00
A031947C292 1   401      .26296.87    .28311.72    .29336.46    .32326.56    .33277.08
A031947C292 2   401      .35197.92    .3898.958    .4219.792    .484.9479
A031947C290C1   402            7  2   .02    .26   8    10.6   -.26180.00          .00
A031947C292 1   402      .02366.15    .03390.89    .08346.35    .13306.77    .17316.67
A031947C292 2   402      .20366.15    .23316.67    .26296.87
A031947C290C1   403            7  2   .01    .22   9    10.6    .26180.00       180.00
A031947C292 1   403      .01435.42    .02494.79    .03494.79    .05415.62    .07316.67
A031947C292 2   403      .09178.13    .1279.167    .1724.74C    .224.9479
A031975C150C1                 3      94
A031975C151C1          3M BLACK VELVET PAINT, 101-C1C.
A031975C190C1  1101            7  5   1.13 20.13  11    10.6   -.26    .00         .00
A031975C192 1  1101     1.13.02697   2.13.C2C22   4.13.01685   6.13.01573   8.13.01685
A031975C192 2  1101     1C.13.01685 12.13.C1742 14.13.01685 16.13.01573 18.13.01348
A031975C192 3  1101     2C.13.01236
A031975C190C1  1102            7  5    .13   .13   1    10.6   -.26180.00          .00
A031975C192 1  1102      .13.05843
A031975C190C1  1103            7  5    .87 19.87  11    10.6    .26180.00       180.00
A031975C192 1  1103      .87.02584   1.87.C2247   3.87.01910   5.87.01854   7.87.01798
A031975C192 2  1103     9.87.01798 11.87.C1775 13.87.01742 15.87.01685 17.87.01629
A031975C192 3  1103     19.87.01573
A032065C150C1                 3      94
A032065C151C1          AEROJET WHITE PAINT .008-.010 THICK, TELESCOPE SUBSTRATE.
A032065C190C1  1C81            7  5   2.13 15.13   8    10.6   -.26    .00         .00
A032065C192 1  1C81     2.13.13647   4.13.10235   6.13.07961   8.13.06368 10.13.03867
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A032065C192 2 1C81    12.13.02729 14.13.C1592 15.13.01365
4J32065C190C1 1082            7  5    .13    .13    1    10.6  -.26180.C0         .00
A0320650192 1 1C82       .13.13419
A032C65C190C1 1C83            7  5   1.87 14.87    8    10.6   .26180.00      180.00
AC32065C192 1 1C83      1.87.12282  3.87.1069C  5.87.07961  7.87.05459  9.87.03867
A032065C192 2 1C83     11.87.02729 13.87.C182C 14.87.01137
A032075C150C1               3       94
A032075C151C1          AEROJET WHITE PAINT .CC8-.010 THICK, TELESCOPE SUBSTRATE.
A032075C190C1 1C91            7  5   2.13 15.13    8    10.6  -.26    .00          .00
A032075C192 1 1C91      2.13.13113  4.13.09269  6.13.06762  8.13.05426 10.13.03617
A032075C192 2 1C91     12.13.02261 14.13.01809 15.13.01356
A032075C190C1 1C92            7  5    .13    .13    1    10.6  -.26180.C0         .00
A032075C192 1 1C92       .13.13791
A032075C19001 1C93            7  5   1.87 14.87    8    10.6   .26180.00      180.00
A032075C192 1 1C93      1.87.12661  4.13.10852  5.87.08591  7.87.05878  9.87.03843
A032075C192 2 1C93     11.87.02713 13.87.C1583 14.87.C1356
```

Appendix F
EXPANDED RETRIEVAL ANALYSIS SYSTEM (ERAS)

ERIM developed and maintains the software referred to as the Expanded Retrieval Analysis System (ERAS). The ERAS format was developed under Air Force sponsorship, has been used by NASA, and is currently available at ERIM in formats compatible with the CDC 1604B and IBM 7094 digital computer systems. All applicable data which have been measured as part of the Optical Measurements and DSO Programs have been placed in this format for future retrieval and ease of reporting. Therefore, that part of the ERAS format is described which is applicable to the measurements data in this particular effort. The reader is then able to readily interpret and use the reported data. (The reader is referred to Reference [2] for a more detailed explanation of the entire system.) Following the format description, the applicable codes being used are also defined.

F.1. DATA UNIT

Each batch of data delivered to AVCO contains a series of Data Units. Each Data Unit consists of all the descriptive material and data associated with a particular experiment. As shown in Table F-1, a Data Unit includes a descriptive material group (major header information) and one or more data set groups.

Table F-2 is an excerpt from a card deck having one major header group and three data set groups. The example is for an Aerojet 2nd Surface Mirror Array measured by ERIM.

A03190101 is the curve identification number specifying the sample number 3190, area 1, condition 01.

Table F-3 shows the general format for each of the card types listed in Table F-1 and used in the printout presented in the example given.

Columns 1-9 contain exactly the same information on every card within the Data Unit. The card numbering (columns 12 and 13) begins anew with each new card type. Columns 14-20 and the general purpose field (columns 21-80) vary according to card type. The individual characteristics of each card type are discussed in the following subsections.

F.2. DESCRIPTIVE MATERIAL GROUP

As shown in Table F-1, the descriptive material group consists of two information blocks. The information included in each of these (and the punch-card type used in the master deck) is discussed in the following sections.

F.2.1. HEADER INFORMATION

Each Data Unit is identified by a single block of header information. In the master deck, the type 50 punch card is used in this information block. The purpose of the type 50 card is to indicate the number of the data sets which make up the given Data Unit and the ordinate dimen-

sion (YCODE1) which describes all these data sets. One and only one type 50 card is included in each data unit. The format for the type 50 card is shown in Table F-4.

Title

The type 51 (Title) punch card is used for this information block in the master card deck. At least one and no more than four title cards will be included in each data unit. Titles are written in columns 21-80, are grammatically correct, and end with a period. They provide a general description of the sample measured.

Data Sets

One or more data sets are included in each data unit. Each data set consists of a sub-header and data block.

Sub-Header Information

This block specifies the dependent variable and the running independent variable (the one against which the dependent variable is "plotted" in the following data set). It also lists the fixed values of the remaining independent variables. In the master card deck, the type 90 (sub-header) punch card is used. One and only one type 90 card is included for each data block within a given data unit. [Recall that only one Header Information (Type 50) card is used for each data unit, no matter how many data sets it contains.] The format for the type 90 cards is shown in Table F-5.

Data Sets

A data set contains the actual digitized data points. The data format allows for a data unit which is composed of a whole family of curves (data sets) in which the dependent variable is plotted against one independent variable for fixed values of up to four other independent variables. For directional reflectance data, a data unit may contain only one data set. In the case of bidirectional data, a data unit may include as many as 10^5 data sets, each consisting of a component which depends on the polarization of the source and the receiver, wavelength, and angles of incidence and observation. Some data curves from certain instruments are given in more than one segment; each segment of a given curve is treated as an individual data set.

In the master card deck, the type 92 (Data) cards are used. These cards contain the actual measurement data; these data consists of cartesian coordinates describing the curve of the dependent variable (e.g., wavelength, λ). The data set number is entered in columns 14-18 on each type 92 card. Columns 21-80 contain five pairs of (x,y) values in a 5(F6.3, F6.2) format. No more than 250 points are allowed. If more than 250 points are required, the additional points are continued in a new data set.

In Tables F-6, F-7, and F-8, the XCODES, YCODES 1, and YCODES 2, respectively, which are routinely utilized in the ERAS format, are presented and defined.

TABLE F-1. DATA UNIT ORGANIZATION

WORD DESCRIPTION	Punch-Card Type Code Used	Number of Cards Used
1. Descriptive Material Group (Major Header)		
a) Header Information	50	1
b) Curve Title	51	1-4
2. Data Set I		
a) Sub-Header Information	90	1
b) Digitized Data Points	92	1-50
3. Data Set II (if required)		
. etc. . . (There is no limit to the number of permissible Data Sets)		

TABLE F-2. CARD FORMAT EXAMPLE

```
A031901015001          3     001
A031901015101        AEROJET SECOND SURFACE MIRROR ARRAY.
A031901019001   1          1  1  .240  .360  19          5.00   .00999.99999.99
A031901019201   1    .240 10.03  .251 11.31  .263 12.54  .273 11.57  .287 10.37
A031901019202   1    .299  9.79  .304  7.03  .310  4.97  .316  4.47  .319  6.11
A031901019203   1    .323 11.02  .326 17.74  .328 30.10  .331 52.31  .335 65.72
A031901019204   1    .339 73.97  .346 79.24  .352 83.32  .360 86.25
A031901019001   2          1  1  .350 1.000   7          5.00   .00999.99999.99
A031901019201   2    .350 91.08  .306 95.53  .488 99.62  .568 99.73  .724100.00
A031901019202   2    .868100.00 1.000 99.74
A031901019001   3          1  1 1.030 2.600  17          5.00   .00999.99999.99
A031901019201   3   1.000100.00 1.021100.00 1.322100.00 1.467100.00 1.677100.00
A031901019202   3   1.885100.00 1.937100.00 1.999100.00 2.039100.00 2.110 99.67
A031901019203   3   2.189 99.02 2.267 98.86 2.346 98.82 2.409 99.59 2.438 98.59
A031901019204   3   2.521 96.57 2.600 94.88
```

TABLE F-3. GENERAL CARD FORMAT

Column	Description	Column Format Code
1-6	Sample Number preceded by A0	A6
8-9	Area Conditon Number*	A3
10-11	Card Type Code	A2
12-13	Card Number (within card type)	I2
14-20	Blank (except card types 50, 90, and 92)	
21-80	General Purpose Fields	Variable, depending on card type

* 1st digit is the area number, 2nd and 3rd digits are the condition number for that area.

TABLE F-4. MAJOR HEADER CARD FORMAT

Column	Description	Column Format Code
21-25	Number of Data Sets	I5
31-33	YCODE 1	I3

TABLE F-5. SUB-HEADER CARD FORMAT

Column	Description	Column Format Code
14-18	Data Set Number	I5
27-29	XCODE (Independent variable)	I3
30-32	YCODE2 (Dependent variable)	I3
33-38	Minimum Value of x	F6.n where $0 \leq n \leq 5$
39-44	Maximum Value of x	F6.n
46-48	Total Number of Points in data set	I3
51-56	Fixed λ, wavelength (μm)	F6.n
57-62	Fixed θ_i, zenith angle of incidence (degrees)	F6.n
63-68	Fixed ϕ_i, azimuth angle of incidence (degrees)	F6.n
69-74	Fixed θ_r, zenith angle of observation (degrees)	F6.n
75-80	Fixed ϕ_r, azimuth angle of observation (degrees)	F6.n

Notes: $\theta_r = \phi_r = 999.99$ denotes integration of the observation angles over the hemisphere

$\theta_i = \phi_i = 999.99$ denotes integration of the incidence angles over the hemisphere

$\lambda = .55$ used to denote .4-.7μm broad band white light source.

TABLE F-6. XCODE DEFINITIONS

XCODE	(Independent Variable) Definition
1	λ, wavelength (microns)
2	θ_i, zenith angle of incidence (degrees)
3	ϕ_i, azimuth angle of incidence (degrees)
4	θ_r, zenith angle of observation (degrees)
5	ϕ_r, azimuth angle of observation (degrees)
6	θ_D, depression angle (degrees)
7	θ_i and θ_r, with $\theta_i = \lvert\theta_r + \text{fixed angle}\rvert$*
8	ϕ_i and ϕ_r, with $\phi_i = \lvert\phi_r + \text{fixed angle}\rvert$*
9	θ_i and θ_r, with $\theta_i = \theta_r$ (Brewster angle)
10	σ, radar cross section (dbsm)
11	f, frequency (GHz)

*Fixed angle specified as θ_i on 90 card.

TABLE F-7. YCODE 1 DEFINITIONS

YCODE1	(Dependent Variable) Definition	YCODE1	(Dependent Variable) Definition
1	ρ_d, directional reflectance (microns)	39	$\epsilon_{\perp}$, emittance received polarized (%)
2	$\rho'_{\parallel\,\parallel}$, polarized bidirectional reflectance (ster^{-1})	40	absolute emittance (0.0-1.0)
3	$\rho'_{\perp\,\parallel}$, polarized bidirectional reflectance (ster^{-1})	94	Arbitrary set of polarized bidirectional reflectance curves (not covered by YCODE1 = 10, 11 or 12)
4	$\rho'_{\parallel\,\perp}$, polarized bidirectional reflectance (ster^{-1})		
5	$\rho'_{\perp\,\perp}$, polarized bidirectional reflectance (ster^{-1})		
6	$\rho'_{0\,\parallel}$, polarized bidirectional reflectance (ster^{-1})		
7	$\rho'_{0\,\perp}$, polarized bidirectional reflectance (ster^{-1})		
8	$\rho'_{\parallel\,t}$, polarized bidirectional reflectance (ster^{-1})		
9	$\rho'_{\perp\,t}$, polarized bidirectional reflectance (ster^{-1})		
10	set of $\rho'_{\parallel\,\parallel}$, $\rho'_{\parallel\,\perp}$, $\rho'_{\perp\,\parallel}$, $\rho'_{\perp}$		
11	set of $\rho'_{0\,\parallel}$, and $\rho'_{0\,\perp}$		
12	set of $\rho'_{\parallel\,t}$ and $\rho'_{\perp\,t}$		
13	Absolute unpolarized bidirectional reflectance (ster^{-1})		
14	ϵ, emittance (%)		
38	$\epsilon_{\parallel}$, emittance received polarized (%)		

Note: With polarized bidirectional reflectance and transmittance, the first subscript denotes source polarization and the second subscript denotes polarization of the receiver. An unpolarized source is indicated by the first subscript equal to "0"; an unpolarized receiver is indicated by the second subscript equal to "t", meaning the total power received. The polarizers are indicated by $\parallel$ (parallel to the reference plane**), $\perp$ perpendicular to the reference plane**).

** The reference plane is either the plane of incidence (formed by the incident beam and the normal to the sample) or the plane of reflection (formed by the reflected rays being detected and the normal to the sample).

TABLE F-8. YCODE 2 DEFINITIONS

YCODE2	(Dependent Variable Definition	YCODE2	(Dependent Variable) Definition
1	ρ_d, directional reflectance (microns)	39	$\epsilon_{\perp}$, emittance receiver polarized (%)
2	$\rho'_{\parallel\,\parallel}$, polarized bidirectional reflectance (ster^{-1})	40	absolute emittance (0.0-1.0)
3	$\rho'_{\perp\,\parallel}$, polarized bidirectional reflectance (ster^{-1})		
4	$\rho'_{\parallel\,\perp}$, polarized bidirectional reflectance (ster^{-1})		
5	$\rho'_{\perp\,\perp}$, polarized bidirectional reflectance (ster^{-1})		
6	$\rho'_{0\,\parallel}$, polarized bidirectional reflectance (ster^{-1})		
7	$\rho'_{0\,\perp}$, polarized bidirectional reflectance (ster^{-1})		
8	$\rho'_{\parallel\,t}$, polarized bidirectional reflectance (ster^{-1})		
9	$\rho'_{\perp\,t}$, polarized bidirectional reflectance (ster^{-1})		
10	ρ, relative unpolarized bidirectional reflectance (%)		
11	ϵ, emittance (%)		
12	DP, degree of polarization (%)		
13	L, radiance		
14	ρ'_{t0}, absolute bidirectional reflectance (ster^{-1})		
15	apparent antenna temperature (°K)		
16	apparent target temperature (°K)		
38	$\epsilon_{\parallel}$, emittance receiver polarized (%)		

Note: With polarized bidirectional reflectance and transmittance the first subscript denotes source polarization and the second subscript denotes polarization of the receiver. An unpolarized source is indicated by the first subscript equal to "0"; an unpolarized receiver is indicated by the second subscript equal to "t", meaning the total power received. The polarizers are indicated by $\parallel$ (parallel to the reference plane**), $\perp$ (perpendicular to the reference plane**).

**The reference plane is either the plane of incidence (formed by the incident beam and the normal to the sample) or the plane of reflection (formed by the reflected rays being detected and the normal to the sample.)

SYMBOLS

d	diameter
$d\Omega_e$	elemental solid angle or emittance
E_i	source irradiance
$Eq\ \rho'_d$	equivalent directional reflectance
e	subscript emission
i	subscript incidence
L_r	reflected radiance
$L_\lambda^b(T;\ \theta_e,\phi_e)$	spectral radiance (power/area-wavelength-solid angle)
$M_\lambda^b(T)$	calculable spectral emittance
$M_\lambda^e(T)$	actual spectral emittance
r	subscript, reflectance
$T[^\circ K]$	absolute temperature
α_s	total solar absorptance
β	bistatic angle
δA	scattering property of surface element
ϵ_d	directional emittance
ϵ_t	total hemispheric emittance
θ	polar angle
θ_e	polar emission angle
$\cos\theta_e$	intensity dependence
$1/\cos\theta_e$	projected area dependence
$\lambda[m]$	blackbody radiation wavelength
ρ_d	conventional directional reflectance
ρ'	directional reflectance
τ	transmittance
ϕ	azimuth
ϕ_e	angularly variable spectral directional emittance

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